VOL. 7 NO. 2
January 31, 1982

Energy Research Abstracts

ABSTRACTS 1716-3128

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830. Telephone (615) 576-1303; (FTS) 626-1303.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $4.50, foreign $5.65 per copy; annual cumulative index, domestic $7.00, foreign $8.75 per copy. The annual subscription price is $48.00 for domestic subscribers and $60.00 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $150.00 for domestic subscribers and $187.50 for foreign subscribers. A single issue costs $6.50 (domestic) or $8.15 (foreign).

The following publications are available to the public on a subscription basis from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $75.00 for domestic subscribers and $150.00 for subscribers outside the North American Continent, except as listed below for *DOE Patents Available for Licensing (PAL)*. A single issue is $7.00 (domestic) and $14.00 (outside the North American Continent).

Current Energy Patents (CEP)

A monthly publication providing abstracting and indexing coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization. Available as PB82-902800.

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Fossil Energy Update (FEU)

A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB82-914600.

Fusion Energy Update (CFU)

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB82-915300.

Geothermal Energy Update (GEU)

A monthly abstract journal devoted to information on the exploration and development of geothermal resources. Available as PB82-914700.

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A semimonthly current awareness bulletin covering the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells. Available as PB82-946600.

Nuclear Fuel Cycle (NFC)

A semimonthly current awareness bulletin covering all aspects of the nuclear fuel cycle, both front end and back end. Available as PB82-813400.

Nuclear Reactor Safety (NRS)

A semimonthly current awareness bulletin covering the following safety aspects: accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures. Available as PB82-913500.

Radioactive Waste Management (RWM)

A semimonthly current awareness bulletin covering the following management aspects: transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers. Available as PB82-902900.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the Energy Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the Energy Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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Vol. 7, No. 2
ISSN: 0160-3604
CODEN: ERABD
January 31, 1982

ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, the Center places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory energy analysis, and policy-related areas. To accomplish this mission, the Center builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to the Center's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of the Center's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Center has developed and maintains systems to record and communicate energy-related research-in-progress information, to catalog official DOE issue-and-policy documents, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications. The Center also maintains a full-scale publishing capability to serve special publication needs of the Department. To effectively manage DOE's technical information resources, the Center's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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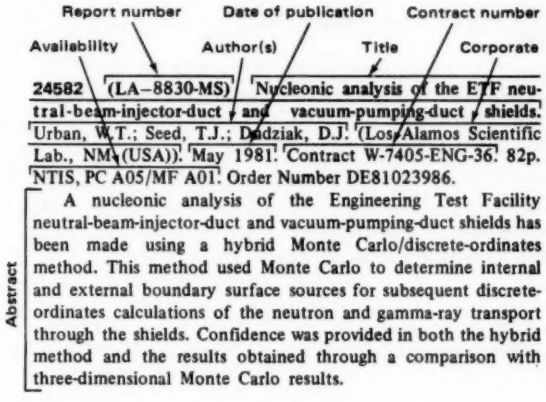
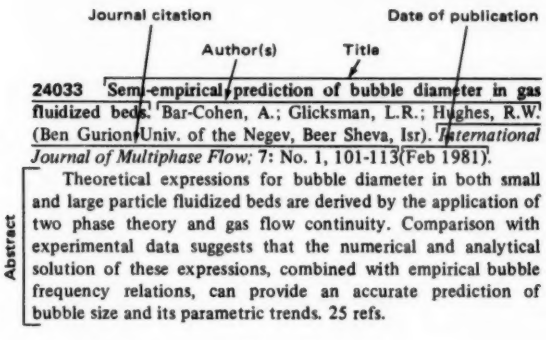
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.

A nucleonic analysis of the Engineering Test Facility neutral-beam-injector-duct and vacuum-pumping-duct shields has been made using a hybrid Monte Carlo/discrete-ordinates method. This method used Monte Carlo to determine internal and external boundary surface sources for subsequent discrete-ordinates calculations of the neutron and gamma-ray transport through the shields. Confidence was provided in both the hybrid method and the results obtained through a comparison with three-dimensional Monte Carlo results.



24033 Semi-empirical prediction of bubble diameter in gas fluidized beds. Bar-Cohen, A.; Glicksman, L.R.; Hughes, R.W. (Ben Gurion Univ. of the Negev, Beer Sheva, Isr). *International Journal of Multiphase Flow;* 7: No. 1, 101-113(Feb 1981).

Theoretical expressions for bubble diameter in both small and large particle fluidized beds are derived by the application of two phase theory and gas flow continuity. Comparison with experimental data suggests that the numerical and analytical solution of these expressions, combined with empirical bubble frequency relations, can provide an accurate prediction of bubble size and its parametric trends. 25 refs.

• INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. **(Los Alamos Scientific Lab., NM (USA)).** May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (LA–8830-MS)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Bar-Cohen, A., Semi-empirical prediction of bubble diameter in gas fluidized beds, 7:24033
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Seed, T.J., *See* Urban, W.T., 6:24582
Urban, W.T., Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (LA–8830-MS)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles or informative phrases, or both, specific to these entries are arranged alphabetically under the entries.

TOKAMAK ETF
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• Contract Number Index

DOE technical literature is indexed using contract numbers under which the literature was produced. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos National Lab., NM (USA)**	
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• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order Number-Report Number Correlation is included for convenience.

LA–		
8830-MS	**6:24582**	**NTIS, PC A05/MF A01. Order Number DE81023986, Distribution Category STD-20d**

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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SUBJECT CONTENTS (ALPHABETICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

0104 Processing

REFER ALSO TO CITATION(S) 1721, 2379

1716 **(DOE/MC/02615—T2) Project C-CLEAR: an assessment of commercial coal liquefaction process equipment performance and supply.** Hao, B.R. (Mechanical Technology, Inc., Latham, NY (USA)). Jan 1980. Contract AT21-77MC02615. 184p. (MTI/WDC—80TR4). NTIS, PC A09/MF A01. Order Number DE81027509.

A broad-brushed assessment was made of the risks involved in using commercially available equipment in full-scale coal liquefaction and gasification plant. Flow diagrams and equipment lists were prepared for a generalized coal liquefaction process based on published data for commercial coal liquefaction and gasification plants. The equipment lists developed show that 225 different types of equipment services are required. With redundancies and active spares, 526 equipment items are identified for each of the five streams of the full-scale coal liquefaction plant. Both the performance risks and the supply risks attending the use of commercial technology and equipment were evaluated. About four percent of the equipment items are in the high risk performance category. They require significant development efforts before present equipment and technology can be used, with confidence, in a full-scale plant. Fifteen percent of the equipment items identified in the study were found to be in size coal particles and choice of a high-softening-point coal would alleviate the coking. 19 references.

1717 **(LBL—11991) Investigation of possible methods for removal of nitrogen from coal-derived and coal-related materials.** Frey, D.D.; Vermeulen, T. (Lawrence Berkeley Lab., CA (USA)). Sep 1980. Contract W-7405-ENG-48. 72p. NTIS, PC A04/MF A01. Order Number DE82001020. Thesis.

A preliminary study was conducted to determine the feasibility of removing nitrogen from hydrogenated coal products by oxidation. Solvent-refined coal, melt-treated coal, and nitrogen containing model-compounds were used as substrates. In addition, various zinc containing catalytic systems were screened for their hydrogenation and hydrocracking activity towards quinoline. Results indicate that nitrogen can be removed from some of the model-compounds used. Both iron and cobalt salts effectively catalyzed the oxidation reaction. Very little nitrogen could be removed from the compounds that are the most representative of hydrogenated coal. In addition, very little nitrogen was removed from the hydrogenated coals themselves. None of the zinc salts tested in the hydrogenation portion of the study were effective in catalyzing the rate of hydrogenation of quinoline.

1718 **(ORNL/Sub—79/13837/6) Foreign coal-liquefaction-technology survey and assessment.** Pay, T.D.; Patel, S.S. (Oak Ridge National Lab., TN (USA); Gilbert Associates, Inc., Oak Ridge, TN (USA)). Oct 1981. Contract W-7405-ENG-26. 341p. NTIS, PC A15/MF A01. Order Number DE82000955.

The Foreign Coal Liquefaction Technology Survey and Assessment is part of the International Energy Technology Assessment effort. Although it might have been desirable to include all technologies from all countries, this was not possible with the resources available. Instead, only six countries were chosen. They are Australia, the Federal Republic of Germany (FRG), Japan, New Zealand, South Africa and the United Kingdom. These countries were selected because they have active coal liquefaction programs, are using or developing technologies that could be used in the US and/or involved with US coal liquefaction programs. To place the programs in these countries into perspective, the resources that each has and the policies that have been adopted by their governments are presented. Although each of these countries has numerous programs underway or planned, the amount of information available on each program varies. Brief descriptions of the programs are given in the first chapter; the second chapter deals only with those liquefaction projects and gasifiers associated with direct liquefaction for which an adequate amount of reference material could be found. Because there are many aspects of direct liquefaction that are critical and for which much development work is still required, there was a need for the third chapter. Here, critical areas common to all or many liquefaction systems are described, making use of material from one or more liquefaction projects. Materials of construction are dealt with as a separate topic. Coal liquefaction has placed new demands on the performance of materials. Hostile environments abound and innovations in materials will be necessary in order for some of the less-developed technologies to reach fruition.

1719 **Coal as a major energy source.** Passman, R.A. (Dept. of Energy, Washington, DC). pp 7-18 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

In this paper, energy policies of the Reagan administration are not discussed because they are in the formulation stage. Rather, general comments are made on some of the problem areas in assessing the coal and mining it, transporting it, and managing the various wastes from combustion. The main focus is on synfuels production and coal conversion activities. An overview of Government programs in synfuels and direct combustion is provided. Proposed projects are divided into four classes; high-Btu gas, low/medium Btu gas, coal liquids, and solid-liquid mixtures. Companies receiving funds are also mentioned. (ATT)

1720 **Coal conversion: importation of foreign technology.** Tennyson, R.N. (Fluor Engineering and Constructors, Inc., Houston, TX). pp 19-41 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

In the United States most of the coal conversion technology is still in the development stage. This means that in the near future, US commercial plants will draw heavily upon foreign technology for both processes and specialized equipment. This paper gives a detailed coverage of the following: US energy consumption, supply and demand; uses of coal; coal conversion processes which include coal gasification and coal liquefaction; technology of coal conversion, shift conversion, acid gas removal processes, and major conversion plants, technology exchange; and future projection for the US. (ATT)

0105 By-products

REFER ALSO TO CITATION(S) 1722

0106 Properties

REFER ALSO TO CITATION(S) 1717, 2190

1721 **(IMMR—48-PD23-80) Distillation tower corrosion: synergistic effects of chlorine and phenolic compounds in coal liquids.** Johnson, T.; Sagues, A.; Davis, B.; Jewitt, C. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research; Ashland Oil, Inc., KY (USA)). Mar 1980. 15p. Univ. of Kentucky, Lexington, KY. Order Number DE82901043.

Severe corrosion problems were encountered in the fractionator area of major solvent refined coal (SRC) pilot plants. Chemical characterization and corrosion experiments using liquids from the T-105 fractionating tower of the Wilsonville, Alabama SRC plant are described. Tower feed liquids were obtained when the plant was processing low and high chlorine content coals without additives. Liquids from individual trays were obtained when the plant feed included additions of sodium carbonate. In summary, the experimental results in this report clearly show that for the plant feed and operational conditions discussed here: (1) much of the chloride in the liquid feed to the T-105 tower is in a water soluble chloride form when a high-chlorine coal is processed; (2) 40 to 50 weight percent of the liquid in the trays in the T-105 tower at the Wilsonville demonstration plant are phenols; these are primarily phenol, cresols, and dimethylphenols; (3) ammonium chloride, when added to the T-105 tray 9 liquid, causes a dramatic (10 fold or more) increase in the corrosion rates of selected coupons; 665 ppM chloride gives laboratory corrosion rates that are close to the high rates observed in the demonstration plant; (4) ammonium chloride addition to the oil fraction (tray 9 liquid with the phenols extracted) does not cause an increase in the corrosion rate; however, the high corrosion rate is observed when the phenol fraction is added back to the oil fraction; (5) the synergistic effect of the ammonium chloride and phenol combination was demonstrated; high solubility of the ammonium chloride in tray 9 liquid, but not in the tray 9 liquid after phenol extraction, indicates that ammonium chloride solubility is at least in part responsible for this synergistic effect. It is likely that a similar cooperative effect is responsible for the Wilsonville tower corrosion.

1722 **Composition of neutral substances in the liquid-phase hydrogenerated product from low-temperature coal tar.** Popova, N.I.; Salimgareeva, F.G.; Klykova, G.G.; Shorokhova, M.V.; Kurban-Galeeva, D.K.; Kalechits, I.V. *Trudy Vostoch.-Sibir. Filiala Akad. Nauk S.S.S.R., Ser. Khim.;* 3: 25-29(1955).

The composition of the liquid-phase product of the hydrogenation of coal tar was determined by means of adsorption by using the method described (in abs. 71). The components of the hydrogenated product are similar in their physical constants to those of the coal tar. The hydrogenated product shows a decrease in unsaturation and the concentration of compounds with functional groups. The change in the nature of the 0 compounds is particularly significant; a decrease in content of OH and ester groups and an increase in the number of carbonyl groups.

0108 Waste Management

REFER ALSO TO CITATION(S) 1724

1723 **(DOE/METC/SP—187) Advanced Environmental Control Technology Program.** (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Aug 1981. 32p. NTIS, PC A03/MF A01. Order Number DE82000898.

The Department of Energy has established the Advanced Environmental Control Technology Program to protect the environment while supporting the development of more efficient and acceptable technologies utilizing domestic fossil fuels. This program consolidates cleanup efforts in ongoing technology-specific DOE programs (such as combustion and gasification, and cleanup projects transferred from EPA to DOE) with new project initiates into a coordinated program that addresses cleanup technology development. There are numerous problems associated with using coal to replace oil and gas as a primary fuel. Sulfur, nitrogen, alkali and halogen compounds, and mineral particulate matter, all found in varying proportions in the domestic coals, are released during gasification and combustion. These contaminants of coal, as well as the soot and tars produced by incomplete combustion or gasification, can potentially degrade the performance of the energy-producing system as well as impacting the qcommunicated to the public. Furthermore, it is likely that particular energy policies will be incorporated into one of the two major dimensions of attitudes and experience, both negative, and opposed accordingly. Policymakers face a challenging situation that could be alleviated only if voters develop a coherent, integrated body of thought on energy issues. 18 references, 4 tables, 5 notes.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 1723, 2214, 2446, 2447, 2448, 2455, 2458, 2461, 2463, 2513, 2624

1724 **Acid rain controversy: coal's achille's heel.** Greenfield, S.M. (Systems Applications, Inc., San Rafael, CA). pp 151-166 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

From the data available today, there is no question that the pH of the rain has dropped in the last two decades in various parts of the world. It is also recognized widely that the increased acidic deposition does have a detrimental impact on ecological systems. It is also true that the lack of knowledge that exists prevents one to look very easily at the processes involved, decide what the actual sources and their relative contributions are, and therefore what the most cost-benefitting strategy should be for alleviating the problem. While it is impossible to quantify the costs and benefits today, EPA appears to be of the opinion that it would benefit the country to reduce the amount of SO/sub x/ and NO/sub x/ emissions that are occurring. What the coal industry is facing, from the standpoint of a potential mitigation strategy, is one that is pointed primarily at ways of reducing the emissions from units that burn coal. Acid rain and the controversy going on are not going to affect, very much, the direction this country is currently headed in with regard to increasing the use of coal. (ATT)

0120 Mining

1725 **(DOE/ET/10023—3-App.A) Development of optimal terrace-pit coal-mining systems. Phase I report: March 1981.** (Kaiser Engineers, Oakland, CA (USA)). Mar 1981. Contract AC01-79ET10023. 149p. NTIS, PC A07/MF A01. Order Number DE82000080.

1726 **(DOE/ET/12483—1) Application of a hydraulic borehole mining apparatus to the remote extraction of coal: field test of borehole crusher system. Final technical report, 18 September 1979-28 November 1980.** Knoke, G.S. (Flow Technology Co., Kent, WA (USA)). Dec 1980. Contract AC01-75ET12483. 280p. NTIS, PC A13/MF A01. Order Number DE81027171.

Extensive factory and field testing of the hydraulic borehole coal mining tool was performed. The tests: (1) characterized cutting nozzle and crusher wear and reliability; (2) characterized cutting, cavity slurry flow, crushing, and slurry pumping processes under field conditions; and (3) compared laboratory cutting and pumping rates with those obtained in the field. The cutting nozzle wear test indicated a nozzle operating life span of at least 400 hours. The crusher reliability test demonstrated that the present crusher drive shifter mechanism can operate up to 8 hours without adjustment; the crusher wear test indicated that the shift mechanism and linkages can operate 100 hours between periods of maintenance. Field production tests demonstrated a cutting rate of 100 tph at 500 hhp. Coal particles averaging 1 inch in size were produced, although some fragments were up to 18 x 18 x 7 inches in size. It was necessary to break up the larger pieces with the cutting jet before they would flow into the sump. This, of course, reduced the average cutting rate. The transport subsystem demonstrated an average rate of 14 tph for crushing and pumping coal from the sump when the working face was more than 10 feet from the sump. The average particle raised to the surface via the slurry jet pump was 1/4 inch

in size; the maximum size was 2 inches. The cutting nozzle and jet pump were shown to be reliable and possesedof good operating life spans while the crusher proved to be the least reliable system component. The production tests demonstrated good cutting rates but indicate the need to increase crushing and pumping capability in order to provide for subsystem compatibilty. It is concluded that design changes will be needed to effect improvements in crusher reliability. It is recommended that a commercial borehole coal mining system be developed and production tested.

1727 **(NP—2901039) Surface mines in West Virginia as of July 1, 1981.** King, H.M.; Smith, C.J.; Jones, H.L.; Campbell, J.D. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1 Jul 1981. 38p. West Virginia Geological Survey, Morgantown, WV, $2.80. Order Number DE82901039.

The purpose of this publication is to provide a quarterly listing of the approximately 1000 surface mines in West Virginia. The following information has been included for each mine: a) company name; b) permit number; c) geological unit(s) indicated on mining permit applications; d) mine status; e) location by United States Geological Survey 7 1/2-minute quadrangle; and f) total bonded acreage. Mines listed are those under permit according to the West Virginia Department of Natural Resources, Division of Reclamation. Not listed are prospecting operations, mines which have been grade-released by DNR, or mines for which reclamation bond money has been forfeited. Individual mines are listed alphabetically by company name under their respective county of operation. Those mines extending across county boundaries have been listed under all counties in which they are located.

1728 **Investigations on geomechanical parameters in relation to outbursts of gas and coal at Leichhardt Colliery, Queensland Coal Mining Co., Blackwater, Queensland. Report No. 9.** Lama, R.D.; Mitchell, G.W. Mount Waverley, Australia; Commonwealth Scientific and Industrial Research Organization (1981). 53p. (NP—2900987). CSIRO, Division of Applied Geomechanics, P.O. Box 54, Mount Waverley, Australia.

This report presents the results of geomechanical tests (index property tests) on coal samples of Gemini Seam at Leichhardt Colliery. These investigations reveal that the surface fracture energy and porosity of bright coal are less than those of dull coals while their internal surface area is greater. The porosity and surface fracture energy of coal samples taken from an outburst area are lower than those where no outbursts occurred. Schmidt hammer impact tests and irregular sample tests can be used to determine the strength and Young's moduli of coal seams and can differentiate reasonably well the test sites or different coal plies at a site.

1729 **Hydrological problems of surface mining.** Wood, P.A. London, England; IEA Coal Research (1981). 102p. (ICTIS/TR—17). IEA Coal Research, 14/15 Lower Grosvenor Place, London SW1W 0EX.

Recent literature concerned with the physical problems arising from the interrelationships between hydrology and the surface mining of coal is reviewed. Both surface water and ground water are considered at all stages of the mining operation: planning, extraction and restoration. Aspects covered include the collection and handling of hydrological data, the construction of river diversions, the control of runoff, erosion and sediment, the problems of ground water and dewatering, and spoil bank hydrology. It is concluded that the interrelatiohips are complex and far reaching, and should be considered to ensure the efficient running of a surface mining operation while adequately protecting the environment. 303 references.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 1753, 1754

1730 **(CONF-8004173—13) Coal as a fuel: a user's viewpoint.** Clodding, C.L. (Bowling Green State Univ., OH (USA)). 1980. 7p. University of Kentucky, Lexington. Order Number DE82900067.

From 19. annual Kentucky industrial coal conference; Lexington, KY, USA (30 Apr 1980).

The problems of a university heating plant burning 25,000 tons of coal per year are described. You cannot burn pulverized coal like the large electric utilities do, but have to use stoker-fed boilers. These have very specific requirements on the coal, so detailed specifications on the coal size, sulfur, volatile matter, ashes, moisture, etc. are required. There are several materials handling problems related to delivery of the coal, stockpiling, reclaiming, feeding, ash handling, etc. Truck delivery is relatively straightforward but expensive; rail delivery of one, or a few cars of coal, which is often frozen and hard to get out of the cars, presents several problems and is also somewhat expensive. (LTN)

1731 **(CONF-8011111—) Mine to market: coal transportation today and tomorrow.** (Norfolk and Western Railway Co., Roanoke, VA (USA)). 1980. 155p. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

Fourteen papers from the proceedings of the meeting Mine to Market: Coal Transportation Today and Tomorrow, have been entered individually into EDB and ERA. (LTN)

1732 (CONF-8011111—, pp 12p, Paper 2) **Port situation at Hampton Roads in 1980.** Bales, W.B. (Norfolk and Western Railway Co., Roanoke, VA). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

In summary, let me reiterate that NW is by no means unwilling or unable to make the investment necessary to ensure its future participation, and that of its system mines, in the growing international steam coal market. At present, our Pier 6, even though it is approaching 20 years old, is the finest metallurgical coal-handling pier in the world. It was carefully planned and designed to meet the exacting needs of export metallurgical coal customers. In the future, we would hope to be able to meet the needs of steam coal shippers equally well.

1733 (CONF-8011111—, pp 8p, Paper 3) **Massey coal terminal involvement.** Baylor, J.M. (A.T. Massey Coal Co., Richmond, VA). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

Plans for a new coal terminal at Newport News, VA, with total storage of 2 million tons and 15 million tons per year throughput are announced. (LTN)

1734 (CONF-8011111—, pp 9p, Paper 4) **Coal slurry pipeline to serve Georgia and Florida.** Dorris, A.D. (Continental Resources Co., Winter Park, FL). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

The benefits of a coal pipeline to the Southeast are obviously very great. We would be remiss if we did not comment that pipelines will not displace railroads and water transportation. If all of the proposed coal pipelines in the United States are built, they will transport less than 150 million tons of coal per year by the year 2000. Data Resources, Inc. estimated that coal transported by rail even with these coal pipelines will increase from 368 million tons in 1980 to 925 million tons by 2000. Clearly, there is a need for much expansion of the railroads even with the coal pipelines. In spite of the many benefits of these pipelines in the Eastern United States, they cannot and will not be built without a law granting federal eminent domain to coal slurry pipelines. Without the right of eminent domain, rights of way for the pipeline cannot be obtained at a

fair price in some cases and at any price in the case of rights of way across railroad property. One final benefit of coal pipelines should be mentioned. They can provide an economical and environmentally benign means to transport coal to seaports for movement overseas. A coal pipeline to the Southeast must be built. The sooner the obstacle of the lack of eminent domain legislation is removed, the sooner the benefits of the pipeline will be realized by the United States.

1735 (CONF-8011111—, pp 7p, Paper 5) **Coal outlook conference.** Gobrecht, J.E. (Chessie System Inc., Cleveland, OH). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

The effects of the Staggers Rail Act is discussed. The author minimizes the effect of the changes in legislation pertaining to railroad regulation. He says the changes will do little to improve the profitability of the railroads in general; that strong railroads will get stronger and weak railroads will get weaker. (LTN)

1736 (CONF-8011111—, pp 9p, Paper 6) **Outlook for US coal exports.** Holmes, C. (National Coal Association, Washington, DC). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

A common theme runs behind the statements of the various foreign visitors to our offices whether they be from Europe or Japan or far eastern countries - their future source of energy is not oil but coal and the United States is considered to be an important source for much of that coal if we can deliver our coals on a reasonably cost competitive basis and if our current transportation problems can be solved. Attractiveness of US coal as a long term option is enhanced by an adequate coal reserves base, a highly competitive coal industry which assures the continued long term availability of coal and is a potentially stable nation that will honor its long term contracts. But despite all these pluses, and the very optimistic forecasts of world coal use and high levels of US coal exports, our future is not automatically assured. Coal production is not a constraint, but transportation capabilities are. And this short-run constraint - especially inadequate port capacities - could prove to put a long run damper on the overseas markets for our coals. As other coals become more available, and they will, our high inland transportation costs coupled with vessel demurrage charges of up to $10 per ton will quickly drive potential customers away from the US and toward cheaper suppliers. The necessity of, and the planning for, more port capacity and the need for accommodating larger vessels (to minimize transport cost) are discussed with some details.

1737 (CONF-8011111—, pp 5p, Paper 7) **Mine to market: trends in water transport.** Kienitz, R.A. (Federal Barge Lines, Inc., St. Louis, MO). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

For those coal producers who can reach the river by short rail haul or by truck, there is a workable, economic way of participating in the export markets. Quite a few shippers were able to divert tonnage to the river. The coal then moved by barge to New Orleans where transfer facilities unloaded the coal for later transfer to vessel; in some cases the barges were unloaded directly to seagoing vessels by equipment provided by the stevedoring companies. Port facilities will need to be expanded and new facilities built to handle the expected upsurge in volume. Officials of the Port of New Orleans indicate that they see a potential for handling capacity approaching 100,000,000 annual tons by 1990. While this number might seem large, I believe from my contacts in this area, that if the trend continues and if spot movements can be converted into longer term contracts such a volume is achievable not only from a facility standpoint but also from the standpoint of the water carriers capability. I might add that we have seen some activity directed toward approval of a dredging program which would provide a 55 foot channel into the New Orleans area. If this is accomplished, larger vessels using the system should result in lower ocean freight costs. Coal is presently moving to export vessels at New Orleans from areas all along the Ohio River from the Pittsburgh area, Huntington-Ashland area down to coal producing areas in West Kentucky and Southern Indiana and Illinois. Some coal is moving from the Tennessee and Arkansas Rivers to New Orleans, also. Most coal for export from the Alabama area moves to Mobile for transloading; however, due to congestion at this port, some coal is being barged to New Orleans.

1738 (CONF-8011111—, pp 6p, Paper 8) **Coal conversion at New England Power Company.** Lawrence, D.W. (New England Electric System, Westboro, MA). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

What do we see in the future for the coast-wise movement of coal. First, we see the uncoupling of the washing plants from the railroads and the railroads from the ships. Ideally, ground storage at both the washing plants and the ports would permit independent operation, and thus optimum efficiency, of all the systems. Second, with our self-unloading ship, we will be able to perhaps supply coal to other utilities or buyers in the New England region, especially in cases where existing unloading equipment has been broken down or removed. Reactivating coal as a source of home and industry heating is a much discussed topic in New England these days. Third, we see coal-oil slurry as a possible fuel for utility coal boilers that are too old and too uneconomical to convert to 100% coal firing, or for utility oil-fired boilers that may be capable of handling some percentage of coal, and very possibly industrial boilers. With our self unloading ship and our large oil tank farm, and our DOE funded coal-oil slurry research project, we think that we'll be able to supply the cheapest oil and coal and, combined with our technology, make coal-oil slurry at an attractive price. These are a few of our key objectives that we will be pursuing over the next few years.

1739 (CONF-8011111—, pp 43p, Paper 9) **Rail contract rate-making and deregulation.** Lawson, J.W. (James W. Lawson, P.C., Washington, DC). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

Summarizing, those of you who have an interest in the development, sale and use of the nation's coal reserves must: (1) actively support appointment by the new administration of persons, who are sympathetic to your interests, to the Interstate Commerce Commission, the Department of Energy, the Department of Transportation, the Council of Economic Advisors, and other relevant government agencies, including the Railroad Accounting Principles Board; (2) Monitor closely and participate actively in the Interstate Commerce Commission rulemaking proceedings engendered by the Staggers Act; and (3) Advocate that the ills of the railroad industry, namely the problems of certain failing carriers, be addressed directly rather than be avoided by the setting of arbitrary jurisdictional standards which have the effect not only of cross-subsidization of uneconomic operations of those failing carriers, but also of excessive rail rates of return to completely healthy carriers at the expense of our nation's economic and energy interests; (4) Challenge any unreasonable existing rates within 180 days or forever lose the right to do so.

1740 (CONF-8011111—, pp 6p, Paper 10) **Railroad deregulation legislation.** Lundgren, R.W. (Detroit Edison Co., MI). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

Electric utilities burn coal in enormous quantities. Utility steam coal has to be transported from distant mine sources, which have become more remote with the increasing reliance on western coal. Generally speaking there is no economically suitable method of transportation except that provided by the railroads. They have an effective monopoly over the preponderance of utility coal movements and they aim to keep it that way by vigorously opposing the development of any viable transportation alternative, e.g., coal slurry pipelines. We are their captive customers because there is no economically feasible alternative to the use of their services at virtually any rate level they choose to impose. Naturally, the railroads don't admit to the desire or even the ability to exploit us. They suggest that the rates they would impose on traffic with high demand characteristics merely reflect the result of differential pricing. They say that captive traffic like ours must pay more than adequately profitable rates because other traffic encounters stiff competition preventing collection of fully profitable rates. But they don't want anyone telling them how much of a differential to charge the captives. They resent outside interference with their managerial prerogatives. I know the feeling and can only say welcome to the club. Electric utilities don't like to answer for their pricing practices either, but we recognize the legitimacy of regulation, wherever there is monopoly power. The railroads appear to want to use their monopoly power by exploiting captive utility coal.

1741 (CONF-8011111—, pp 7p, Paper 11) **Presentation of Louis H. Meece.** Meece, L.H. (International Marine Terminals, New Orleans, LA). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

The US coal export boom rests on what we consider to be two very solid foundations. The first was that same increase in oil prices which has so influenced ocean rates as to nearly double rates from Australia to the US and from Australia to Europe. The second leg has been the extremely rapid conversion in Europe from oil to coal. Their politicians tend to be much more pragmatic and forceful than ours in seeing and acting upon a major national crisis. The combination of these two factors has suddenly and immediately made American coal highly competitive in European markets which were formerly almost the private domain of Poland, Australia, and South Africa. We are today probably less expensive than Australian coal and competitive with South African coal. Add to these two basic changes, the additional factors of the strikes in Poland and their inability to meet current shipping schedules; the greater demand apparently placed on Polish coal for other eastern block nations; the almost complete utilization of available terminal capacity in South Africa until the Richards Bay expansion is complete in 1985; and the similar near-capacity conditions in Australian steam coal ports together with the major disruption of the Australian coal industry by strikes this year and the results are truly dramatic. The author expects a major portion of increased US exports to be through New Orleans.

1742 (CONF-8011111—, pp 17p, Paper 12) **Viewing the world for one month from a Hampton Roads coal vessel, or is it wrong to fall in love with sour cream.** Price, J. (Dean Witter Reynolds Inc., New York, NY). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

This paper includes: (1) a detailed look at latest steam and metallurgical export figures; (2) what's going on; (3) where we are headed; (4) some individual country commentaries; (5) the ports - a quick status report; demurrage; a look at expansion; and some unexpurgated remarks; (6) rail deregulation - quick and dirty; (7) the reasons for these changes (mining shortfall in Poland, reluctance to do business with South Africa, OPEC price increase, depth of European coal mines and therefore high cost of coal and high cost of financing inventory and resultant moderate selling price of stockpiled coal).

1743 (CONF-8011111—, pp 7p, Paper 13) **Between mine and market: the outlook for rail transportation of coal.** Stram, B.N. (Interstate Commerce Commission, Washington, DC). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

For shippers, greater reliance on the marketplace means that you must look at and for alternatives. If you can find alternatives, you've got leverage for bargaining with a railroad. For the railroads, I have a similar message. If you're contemplating a business arrangement that makes economic sense, but you think the Commission won't approve it, think again. Finally, the Rail Act does provide limited protection to captive shippers. Above specific jurisdictional limits, the Commission may conduct investigations of rates and ultimately prescribe rate levels. The question clearly arises as to what role the Commission should play in providing protection in these instances where the statute defines shippers to be captive. Speaking as an economist, I would have to suggest that, if one argues that there do exist shippers who remain captive over the long term, one must also logically maintain that there are for the long term substantial fixed costs in the rail industry. Therefore, if the Commission is to regulate in the long term to protect captive shippers, it must regulate as if there were substantial long term fixed costs in the rail industry. Economic theory tells us very clearly that social efficiency is fostered if such costs are allocated in inverse proportion to elasticity of demand. That is, inelastic traffic should bear a disproportionate share of fixed costs. Since captive traffic is by definition inelastic, long term regulatory intervention logically carries with it the implications that captive traffic bear a disproportionate share of fixed costs.

1744 **Coal production and transportation.** San Francisco, CA; PLM, Inc. (1981). 256p. (CONF-810265—). PLM, Inc., 50 California Street, San Francisco, CA 94111.

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

Sixteen papers covering a wide variety of topics relevant to today's coal industry and a panel discussion on railroad deregulation and coal unit train rates were presented at the Seventh Annual PLM Coal Conference on Coal Production and Transportation. This volume contains all of these papers, which cover the topics ranging from acid rain to project financing, from slurry pipelines to barge and railroad transportation, as well as the panel discussion. All papers have been abstracted and indexed.

1745 **Supplying coal to major utilities.** Smith, F.K. (Utility Fuels, Inc., Houston, TX). pp 1-6 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

Texas Utility Company had some of the lowest electric rates due to abundant and cheap supplies of natural gas. However, with the rise in the cost of natural gas, and the passage of the Industrial Fuel Use and Power Plant Act of 1978 which mandates that utilities stop using natural gas for a boiler fuel somewhere around 1990, the Light Company looked to coal as a substitute fuel. Utility Fuels undertook to supply coal to the Light Company by purchasing over 1000 rail cars to haul coal purchased from western mines in Wyoming and Montana. The first delivery was made in 1978, and in August of that same year the Houston Light and Power Company's (HL and P) coal-fired unit achieved a 100% coal burn. Today, HL and P's three coal-fired units account for about 12% of its generating fuel mix, and by 1990, coal and lignite will represent 43% of the HL and P fuel mix. Coal transportation by rail has, however, turned out to be costly. Rates have escalated to the point where the utilities are paying almost twice of the amount of the cost of coal from the mine. The need for a supplementary mode of transportation such as a coal slurry pipeline is mentioned. Some relief from high coal hauling rates will be obtained when HL and P begins utilizing Texas lignite in the mid 1980s and beyond. (ATT)

1746 **Barge transportation of coal: inter-modal movement, rail to river.** White, J.N. (American Commercial Terminals, Inc., St. Louis, MO). pp 43-67 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

This paper describes, with the aid of photographs, how coal or any other commodity in mass tonnage is transported from one place to another. Specifically, the routes described here are from the coal mines of Gillette, Wyoming to Cajun Electric at New Roads, Louisiana. The coal is shipped from the Powder River Basin by rail to St. Louis where it is stored and transloaded onto barges to be shipped to New Roads, Louisiana. The photographs show the method and equipment used to load and unload a unit train and a barge. (ATT)

1747 **Outlook for the long distance slurry pipeline industry.** Wasp, E.J. (Energy Transportation Systems, Inc., San Francisco, CA). pp 69-81 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

Major applications of slurry systems have been overseas and these have been for the transport of mineral concentrates, such as iron and copper. In the United States the major emphasis has been and will be on coal slurry pipelines. The first long distance coal slurry pipeline was built in Ohio in 1957. The only coal slurry system in operation is the Black Mesa system in Arizona. There are seven projects, involving a total investment of 10 billion dollars, planned for coal slurry pipelines in the next decade. Slurry pipelines have been slow developing in the United States for the following two reasons: resistance of the railroads by their preventing the pipelines from crossing under their tracks; and the continuing controversy over the use of water for the slurry mixture. In the case of the Energy Transportation Systems, Inc. (ETSI) pipeline both of these issues have been settled, and construction is expected to begin two years from now. The National Coal Association forecasts that up to 1.1 billion tons of coal will be mined by 1985 and as much as 1.5 billion tons by 1990. These figures compare to a projected 8 million tons for 1981, which will be transported by rail or barge except for the 4 or 5 million tons transported by the Black Mesa pipeline. The emerging coal slurry industry still would handle only 12% of the total coal traffic projected for the year 1990. Advantages offered by the coal slurry pipelines are:they foster competition; they offer about one-third the inflation rate that railroads have; they save electric consumer dollars; and they are environmentally sound. (ATT)

1748 **Coal hopper car door systems.** Gibson, W. (Miner Enterprises, Inc., Geneva, IL). pp 135-137 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

AutoMEC, a bottom discharge system for unloading open top hopper coal cars is described. This is a method of quickly discharging coal from open top hopper cars while the train moves continuously over a pit or trestle at the power station. AutoMEC can be applied by any car builder to fit their own, or their customer's coal car design. (ATT)

1749 **Frozen coal and other transportation problems.** Harrington, P.D. (Union Electric Co., St. Louis, MO). pp 139-150 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

The use of Freezing Conditioning Agents (FCA) have diminished considerably the frozen coal problems associated with the transport of coal during the winter months. FCA's are like antifreeze in that when sprayed on coal, they react with surface moisture and prevent ice crystals from forming a solid bond. The freezing conditioning agents are usually made up of 80% ethylene glycol and 15% of wetting agents or No. 2 fuel oil with chemical additives. Both mixtures seem to work equally well and experiments are being conducted at Union Electric to determine which one will give better freeze protection at minimum cost. (ATT)

1750 **Getting coal to market: a producer's look at coal transportation.** Drummond, G.K. (NERCO, Inc., Portland, OR). pp 167-180 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

The major transportation problems for the coal industry are rising freight rates followed by inadequate port facilities and government policies such as the Rail Deregulation Act and captive coal rate policy proposed by ICC, which will allocate the major portion of constant costs to heavy-loading traffic such as coal. To solve these problems the most important thing coal shippers can do is to support development of competitive transportation, such as the coal slurry pipeline which is one form of competition and is a necessary alternative to rail transportation. In addition to promoting competition, coal shippers must continue to call for reasonable rates based on true cost of service, and pursue opportunities for contract ratemaking. Lastly, in order to take advantage of coal export opportunities, ports must be dredged and developed to handle coal shipments. (ATT)

1751 **Coal's future on the Missouri Pacific.** Austin, J.A. (Missouri Pacific Railroad, St. Louis, MO). pp 199-204 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

Coal delivered by the Missouri Pacific Railroad (Mo-Pac) rose from 14.6 million tons in 1977 to 32.2 million tons in 1980, and it is estimated that it will rise to 49 million tons in 1983. This growth is due to increased production from modern mines in Southern Illinois, increasing use of low-sulfur western coal is the eastern half of the nation, and the location of numerous coal using industries on the Mo-Pac's lines. Mo-Pac serves a 12-state area in the Midwest, South and Southwest, and also handles coal moving to the East and Southeast through rail and rail/barge connections. The company is in the process of a multi-million dollar capital investment program for the reconstruction of its principal cost-carrying lines. In addition, it has established a sales and marketing staff which deals with coal traffic, and has gone into unit train operations. (ATT)

1752 **Moving coal in the eighties: Chicago and North Western's challenge in the Powder River Basin.** Wolfe, J.R. (Chicago and North Western Transportation Co., Chicago, IL). pp 205-215 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

For Chicago and North Western Transportation Company, coal is the largest single commodity hauled, second only to grain as a revenue producer. Last year North Western hauled over 208,449 carloads of coal, 20 million tons, mostly in unit trains, that produced a total of $81,600,000 in revenues, a 21.7% increase in carloads and a 50.4% increase in revenues over 1979. North Western is presently involved in the construction and rebuilding of existing lines of railroad in Wyoming to tap the rich coal deposit in the Powder River Basin. To finance the cost of the rebuilding of existing line and to build a connector line to Union Pacific and to pay Burlington Northern one-half share of the cost of building the already-operating line that taps the Powder River Basin coal deposits, North Western applied for a loan guarantee under terms of the Railroad Revitalization and Regulatory Reform Act. The project is at this point where the loan guarantee is pending at the Federal Railroad Administration, and the final phases of the environmental impact statement are being completed. (ATT)

0140 Combustion

REFER ALSO TO CITATION(S) 1724, 1730

1753 (CONF-8011111—, pp 12p, Paper 1) **Development of coal-water slurries as a fuel for steam boilers.** Henderson, C.B.; Scheffee, R.S. (Atlantic Research Corp., Alexandria, VA). 1980. Pasha Publications, 1730 K Street, NW, Suite 713, Washington, DC. Order Number DE82900170.

From 3. annual coal outlook mine to market: coal transportation today and tomorrow conference; Arlington, VA, USA (10 Nov 1980).

This paper reviews briefly the development at the Atlantic Research Corporation of coal-water slurries as a fuel for use in steam boilers. These slurries have been given the name ARC-COAL. The formulation, stability, flow properties, and combustion of ARC-COAL are described. This development effort has been funded by the DOE, EPRI, and the Atlantic Research Corporation. The coal-water slurries developed thus far should be transportable by ship, barge, train, and truck and also by pipeline over short distances. Efforts to develop a slurry which would simultaneously be a useful fuel and transportable by pipeline over long distances have only just begun. A brief discussion of the objectives and an appraisal of the potential for success is given. This activity is being sponsored solely by the Atlantic Research Corporation.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 1744, 1745

1754 **Coal exports and port capacities.** Holmes, C. (National Coal Association, Washington, DC). pp 107-118 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

As most of the coal-fired boilers of the european countries began coming on line in late 1979 and 1980, demand for coal by these countries increased at the annual rate of 4.2%, 1976 through 1979, to 11% in 1980. Imports from the United States increased marginally, 1978 to 1979 but rose in 1980 by 90%. Inspite of United State's record shipment of coal, at least 10 million tons of coal were sold but not delivered to the docks for export because of the limited coal-loading facilities at the ocean ports. This has resulted particularly in the east coast to vessel buildup as they wait for coal loading. Shipping delays are also heightened by the lack of deep water ports, which prevents the use of larger and more cost-efficient vessels. The increased costs caused by vessel delays, which the customers pay, because of insufficient port loading capacity including modern bulk handling and storage facilities at coal ports, and the lack of deep water ports could cause United States to lose a good share of the new market. The many short term measures which have been developed to make the most of the existing coal port and loading facilities, and need for constructing deepwater ports and the means of financing this project are discussed. For United States to be a leading exporter of coal, the transportation system must be improved so as to meet delivery datelines. (ATT)

1755 **Project financing fo the coal industry.** Quigley, J.J. (Continental Illinois National Bank, Chicago). pp 119-134 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

The definition of project financing used by most major US banks is a financing where the lender is looking principally to the cash flow from the asset for repayment. The degree of recourse to the sponsor is what differentiates a project financing from a corporate credit. The less recourse, the more project financing oriented it is. These transactions are put together by three major types of financings: production payments, leasing, and subsidiary and/or joint ventures. The advantages of project financing are: borrower can usually get a longer loan term; borrowings and repayments can be tailored to a specific mining property; one can obtain funds where otherwise precluded by existing loan documentation; possibility of off balance sheet financing or reduced disclosure; ability to finance projects which are large relative to the sponsor's existing size; and greater potential leverage improving return on equity. The disadvantages are: potentially higher borrowing cost due to additional risk being assumed by lender; and additional negotiations on risk sharing aspects and likely more documentation. (ATT)

0160 Health And Safety

REFER ALSO TO CITATION(S) 2078, 2214, 2500, 2502, 2503

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 1750

1756 **(NP—2900667) Impact of the Clean Air Act on coal synthetic-fuels production at five study sites. Report of the American Petroleum Institute Coal Synfuels Case Study Group.** (American Petroleum Inst., Washington, DC). 20 Aug 1981. 104p. American Petroleum Institute, Washington, DC. Order Number DE82900667.

The impact of existing and alternative Clean Air Act (CAA) legislation and attendant regulations on production of synthetic liquid and gaseous fuels from coal was examined at five study sites located in: (1) Appalachia, (2) Southeastern Ohio, (3) Northwestern New Mexico, (4) Northwestern Colorado, and (5) West Central North Dakota. Production forecasts for the years 1990 and 2000 showed that severe constraints to the siting and/or subsequent expansion of synfuel facilities can be expected with current regulations under the existing Clean Air Act (CAA). Three Clean Air Act scenarios were defined by the study group: (1) The Base Case - Production Possible with Current Regulations Under the Existing Clean Air Act. (2) Alternative Case 1 - Production Possible with Authorized Regulations Under the Existing Clean Air Act. (3) Alternative Case 2 - Production Possible with New Regulations under a Revised Clean Air Act. The study showed that, by the years 1990 and 2000, current regulations under the existing Clean Air Act can be expected to severely constrain the siting and/or subsequent expansion of synfuel facilities. Possible future regulations authorized by the existing CAA would make these constraints even more serious. By contrast, the study showed that new regulations under a revised CAA would greatly ease these constraints so that a viable synfuels industry would be possible without violating the primary or secondary National Ambient Air Quality Standards (NAAQS).

02 PETROLEUM

0203 Drilling And Production

1757 **(NP—2900668) Impact of the Clean Air Act on heavy-oil production in Kern County.** (American Petroleum Inst., Washington, DC). 20 Aug 1981. 176p. American Petroleum Inst., 2101 L. Street, NW, Washington, DC 20037. Order Number DE82900668.

The Clean Air Act, as amended in 1977, has hampered Thermally Enhanced Oil Recovery (TEOR) production in Kern County, California. Constraints imposed by the Clean Air Act (CAA) and its attendant regulations have impeded expansion of heavy oil production capacity. These constraints include the complexity and delay in permitting of new facilities, stringent Ambient Air Quality Standards, inappropriate mechanism for the determination of non-attainment areas, fixed attainment deadlines, and offset requirements. These constraints, their effects, and proposed changes are summarized in Table 1. In the most restrictive case, with strict interpretation of the Clean Air Act and all constraints in effect, net heavy oil production in Kern County would be limited to a range somewhere between current levels of about 278,000 barrels a day and 437,400 barrels per day, if all currently permitted production is developed. With the elimination of the construction ban, improved permitting, and relaxation of other constraints, net production of heavy oil in Kern County could increase to a level of about 783,500 barrels a day by 1990. All increases in net heavy oil production are attributable to increases in steam generation capacity.

1758 **Simulation: a new tool in production operations.** Taylor, F.R. (Conoco North Sea Inc). *Proc. Eur. Offshore Pet. Conf. Exhib., London, Eng., Oct 21, 1980;* **2**: 17-24(1980). (CONF-8010200—).

From 1. European offshore petroleum conference exhibition; London, UK (21 Oct 1980).

A description is given of the process control simulator developed by Conoco North Sea Inc. for the Murchison field in Block 211/19 of the UK North Sea and its use to train operating staff. This /1.3 Million system duplicates panels found offshore in the module control rooms for oil production, oil/gas metering and transport, and gas handling. The scope of the simulatuon encompasses oil and gas production from the wellhead through three stages of separation to the pipeline pumps and into the Brent pipeline system. For the gas the model simulates compression followed by either gas injection to the reservoir or to a sales gas pipeline.

0207 Marketing And Economics

1759 **(NP—2900669) Mandatory petroleum price and allocation regulations: a history and analysis.** Lane, W.C. Jr. (Kaye, Scholer, Fierman, Hays and Handler, Washington, DC (USA)). 5 May 1981. 241p. American Petroleum Inst., 2101 L. Street, NW, Washington, DC 20037. Order Number DE82900669.

This study is a history and analysis of Federal controls over petroleum price and allocation decisions throughout the 1970's. It relies in large part on the many analyses and comments written by academics, government officials and others who have studied the topic over the past nine years. The first part of this study outlines the conditions in the domestic petroleum market that led to the imposition of first price, and then allocation controls on the oil industry. The second part explores the operation and effectiveness of the regulations during periods of oil supply disruptions - the Arab embargo of 1973-1974 and the 1979 shortfall attendant to the revolution in Iran. The third part describes many of the more important changes made to the regulations during non-disrupted periods, and examines the effect the regulations had on the operation and structure of the domestic oil industry. The last part analyzes the overall effects of the regulations on consumer prices and national welfare.

1760 **(USGS-OFR—80-17) Outer continental shelf oil and gas activities in the Mid-Atlantic and their onshore impacts: a summary report, November 1979. Update 1, June 30, 1980.** Deis, J.L. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). 1980. 19p. Geological Survey, Reston, VA. Order Number DE82900821.

This update presents new information about the Mid-Atlantic continental shelf (OCS) for the period from December 1979 through June 1980. A summary of geologic reports and findings is presented. Resource estimates are included. The magnitude and timing of offshore development and exploration activity is described. Lease Sale 59 will be the third lease sale in the Mid-Atlantic OCS and is tentatively scheduled for December 1981. Since the original summary report, the number of active exploring drilling rigs has been between 2 and 3 and the related onshore support activities is remaining constant.

1761 **(USGS-OFR—80-626) Outer Continental Shelf oil and gas activities in the South Atlantic (US) and their onshore impacts: a summary report, July 1980.** Jackson, J.B. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). 1980. 71p. Geological Survey, Office of OCS Information, 640 National Center, Reston, VA 22092. Order Number DE82900816.

Activity in the search for oil and gas on the Outer Continental Shelf (OCS) in the South Atlantic Region began in 1960 when geophysical surveys of the area were initiated. In 1977, a Continental Offshore Stratigraphic Test (COST) well was drilled in the Southeast Georgia Embayment. In March 1978, the first lease sale, Sale 43, was held, resulting in the lease of 43 tracts. Approximately a year later, in May 1979, the first exploratory vessel began drilling, and by February 1980, six exploratory wells had been drilled by four companies. However, hydrocarbons were not found in any of these wells. As of mid-February 1980, exploratory drilling activity had ceased, and none was planned for the near future. The next lease sale, Sale 56, is scheduled for August 1981. The most recent risked estimates (January 1980) by the US Geological Survey of undiscovered, economically recoverable oil and gas resources for the 43 tracts currently under lease in the South Atlantic Region are 7.9 million barrels of oil and 48 billion cubic feet of natural gas. On the basis of geologic information from wells completed to date, current prices of oil and gas, and the expense of constructing a pipeline to bring the hydrocarbons ashore, these resource estimates for currently leased tracts in the Region appear to be short of commercially producible amounts. Onshore impacts resulting from OCS exploration have been minimal. Tenneco, using existing facilities, has established a support base in Savannah, Georgia; Getty, Transco, and Exxon have used a support base established for them by the City of Brunswick, Georgia. All the companies have used a helicopter service operating from St. Simon's Island, Georgia.

1762 **(USGS-OFR—80-645) Outer Continental Shelf oil and gas information program: outer continental shelf oil and gas activities in the Pacific (Southern California) and their onshore impacts. A summary report, May 1980.** Macpherson, G.S.; Bernstein, J. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). 1980. 144p. Geological Survey, 640 National Center, Reston, VA 22092. Order Number DE82900805.

Outer Continental Shelf (OCS) oil and gas exploration and development have been under way in the Pacific (Southern California) Region since 1966. During that time, there have been four Federal lease sales. Oil and gas production from three leases has been going on since 1968. It peaked in 1971, and now averages around 31,400 barrels of oil and 15.4 million cubic feet of gas per day. Discoveries on areas leased in the 1968 and 1975 sales have led to plans for eight new platforms to begin production in the early 1980's. Five platforms are in the eastern end of Santa Barbara Channel, one is in the western Channel, and two are in San Pedro Bay, south of Long Beach. Three rigs are doing exploratory drilling in the Region. The most recent estimates by the US Geological Survey of remaining reserves for all identified fields in the Southern California Region are 695 million barrels of oil and 1575 billion cubic feet of gas (January 1979). Risked estimates of economically recoverable resources of all leased tracts are 394 million barrels of oil and 1295 billion cubic feet of gas. The USGS estimates of undiscovered recoverable resources for the entire Southern California OCS Region (January 1980) are 3200 million barrels of oil and 3400 billion cubic feet of gas. Because of the long history of oil and gas production in Southern California from wells onshore and in State waters, there are many existing facilities for the transportation, processing, and refining of oil and gas. Four new onshore projects will be required.

1763 **(USGS-OFR—80-864) Outer Continental Shelf oil and gas information program: outer continental shelf oil and gas activities in the Gulf of Mexico and their onshore impacts. A summary report, September 1980.** Havran, K.J.; Collins, K.M. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). 1980. 111p. Geological Survey, 640 National Center, Reston, VA 22092. Order Number DE82900804.

The Gulf of Mexico Outer Continental Shelf (OCS) is an important oil- and gas- producing region with a long history. Its volume of production is greater than that of any other offshore region in the world. Most of the known hydrocarbon deposits in the area are situated off the coasts of Texas and Louisiana, where geologic structures associated with salt tectonism are responsible for oil and gas entrapment. Cumulative production from these fields to January 1, 1979, has yielded 3.76 billion barrels of oil and condensate and 39 trillion cubic feet of gas. Remaining recoverable reserves are 2.76 billion barrels of oil and 37.2 trillion cubic feet of gas, distributed among 385 known fields. Undiscovered recoverable resource estimates for the Gulf of Mexico are 6.5 billion barrels of oil and 71.9 trillion cubic feet of gas. Exploration and development activity in the Gulf is continuing, with 109 offshore mobile drilling units currently active. Production platforms, which presently number 2432, generally produce sweet, light crude oil and gas. Gulf of Mexico OCS production platforms are linked to shore by an extensive network of pipelines that transport daily production of 750,000 barrels of oil and 13.1 billion cubic feet of gas to nearby coastal locations. To offset the decline in Gulf OCS production, offshore operators are engaging in techniques to enhance recovery. Transportation of oil and gas is a concern in areas of offshore production. For reasons of safety and economics, pipelines are the preferred transportation mode. However, small quantities of OCS oil are moved by tanker and barge. One deepwater port designed to accommodate supertankers is also under construction in the Gulf.

Onshore and offshore oil and gas production along the Gulf Coast has resulted in the growth of an impressive industrial complex. The economic base of the Gulf Coast States is closely tied to the global oil and gas industry.

1764 **(USGS-OFR—80-1201) Pacific index, January 1962-October 1980. Outer Continental Shelf Oil and Gas Information Program.** Kolasinski, S.L. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). 1980. 115p. Geological Survey, Office of OCS Information, Reston, VA 22092. Order Number DE82900806.

This index begins by presenting information on the OCS leasing process and on the most recent OCS oil and gas leasing schedule. Information is presented on the 1963, 1964, 1966, and 1968 lease sales, as well as lease sales number 35, 48, 53, 68, and 73. A detailed description of each of the steps in the OCS leasing process, from a national perspective, is presented. Following the description of each step, all relevant documents associated with the step are then listed for every sale in the region. Ongoing programs of the Bureau of Land Management and the US Geological Survey that are carried out to support the OCS leasing process are described. The final section presents information on state involvement in the leasing process, as well as a directory of state and federal OCS-related contacts. Appendixes provide additional information pertinent to the OCS leasing process.

1765 **(USGS-OFR—80-1202) Atlantic index, January 1975-November 1980. Outer Continental Shelf Oil and Gas Information Program.** Salzmann, M.A. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). 1980. 198p. Geological Survey, Office of OCS Information, Reston, VA 22092. Order Number DE82900807.

This updated index begins by presenting information on the OCS leasing process and on the most recent OCS oil and gas leasing schedule. Lease sale histories on the following lease sales are presented: 40, 43, 49, 54, 42, 56, 59, 52, 76, 78, and 82. A detailed description of each of the steps in the OCS leasing process, from a national perspective, is presented. Following the description of each step, all relevant documents associated with the step are then listed for every sale in the region. Ongoing programs of the Bureau of Land Management and the US Geological Survey that are carried out to support the OCS leasing process are described. The final section presents information on state involvement in the leasing process, as well as a directory of state and federal OCS-related contacts. Appendixes provide additional information pertinent to the OCS leasing process.

1766 **(USGS-OFR—81-20) Outer Continental Shelf oil and gas information program: Alaska index (December 1974-November 1980).** Dorrier, R.T. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). 1980. 89p. Geological Survey, 640 National Center, Reston, VA 22092. Order Number DE82900809.

This index begins by presenting information on the OCS leasing process and on the most recent OCS oil and gas leasing schedule. Information is presented on the lease sale histories of the following Gulf of Alaska and Bering Sea lease sales: 39, CI, BF, 55, 60, 57, 70, 71, 61, 75, 83, 85, and 86. A detailed description of each of the steps in the OCS leasing process, from a national perspective, is presented. Following the description of each step, all relevant documents associated with the step are then listed for every sale in the region. Ongoing programs of the Bureau of Land Management and the US Geological Survey that are carried out to support the OCS leasing process are described. The final section presents information on State involvement in the leasing process, as well as a directory of State and Federal OCS-related contacts. Appendixes provide additional information pertinent to the OCS leasing process.

1767 **(USGS-OFR—81-25) Outer Continental Shelf oil and gas activities in the South Atlantic (US) and their onshore impacts: a summary report, July 1980. Update 1, February 1981.** Havran, K.J. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). Feb 1981. 19p. Geological Survey, Office of OCS Information, 640 National Center, Reston, VA 22092. Order Number DE82900815.

Lease Sale 43, in the Southeast Georgia Embayment, was the first lease sale to be held in the South Atlantic. Two additional sales are scheduled between now and 1985: Sale 56 is scheduled for August 1981 and Sale 78, for January 1984. All leases from Sale 43 remain active, but no drilling has taken place since the last of six dry holes was plugged and abandoned. There are no additional plans for drilling on Sale 43 leases in the immediate future. Future exploration may shift away from previous Sale 43 leased tracts to deep-water areas after Sale 56. One hundred thirty of the 286 proposed Sale 56 tracts are in deep-water. The geologic conditions in the deep-water areas are more favorable for hydrocarbon accumulation than those under shallower waters. Structures that may provide trapping mechanisms have been shown to exist in the area. Because leases in deep-water areas take longer and are more costly to explore and develop than those in areas of shallower water, industry consensus is that longer primary lease terms may be required and some delays in acquiring rigs may be experienced. The Sale 43 area appears to be a region of relatively low hydrocarbon-bearing potential. However, the Bureau of Land Management's Intergovernmental Planning Program is preparing the necessary Regional Transportation Management Plan for the entire South Atlantic OCS Region. Nearly all the support facilities associated with Sale 43 have been removed or converted to other uses. Temporary support facilities are likely to be reactivated only if Sale 56 results in further exploration of the South Atlantic OCS.

1768 **(USGS-OFR—81-601) North Atlantic summary report. Outer continental shelf oil and gas activities in the North Atlantic and their onshore impacts. A summary report, July 1981.** Dorrier, R.T. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). 1981. 71p. Geological Survey, Office of OCS Information, Reston, VA 22092. Order Number DE82900808.

The leasing process for oil and gas exploration on the North Atlantic Outer Continental Shelf (OCS) began in June 1975. The first lease sale in the region (Lease Sale 42) was scheduled for January 31, 1978, by the Department of the Interior. However, the sale was delayed for 23 months by litigation before it was finally held on December 18, 1979. Of the 116 tracts offered, 63 tracts comprising 358,671 acres were leased as a result of the sale. Eight exploration plans have been submitted by five oil companies since Lease Sale 42. The plans call for exploratory drilling on 11 separate tracts in the lease sale area. The plans and the required federal drilling permits for two blocks, Exxon's block 133 and Shell's block 410, have been approved. Exploratory drilling on these two blocks began on July 24, 1981. The review process to approve the other plans and the required OCS drilling permits is in progress. Onshore impacts resulting from OCS exploration in the North Atlantic are expected to be minimal. The same support base at Davisville, Rhode Island, used for drilling operations in the Mid-Atlantic Region is servicing North Atlantic activities. This facility has more than enough capacity and berthing space to service the level of activity expected during exploratory drilling. Moreover, support requirements for the North Atlantic are expected to supplement the declining level of support activity that has occurred for the Mid-Atlantic Region.

1769 **(USGS-OFR—81-603) Outer Continental Shelf oil and gas activities in the Mid-Atlantic and their onshore impacts: a summary report, November 1979. Update 2, February 1981.** Dorrier, R.T. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). Feb 1981. 24p. Geological Survey, Office of OCS Information, 640 National Center, Reston, VA 22092. Order Number DE82900820.

The level of activity of oil and gas exploration on the Mid-Atlantic Outer Continental Shelf (OCS) has remained constant, with two drilling rigs operating during the period from June through December 1980. Gas flows in two wells were announced in November, but neither has been shown to be commercial at this time. A third lease sale in the Mid-Atlantic Region, Lease Sale 59, is scheduled to be held in December 1981. The proposed sale area is in deeper water, seaward of existing leased tracts. Recent drilling results and preliminary geophysical investigations indicate a greater potential for resources in this area than in the two earlier lease sale areas on the Mid-Atlantic Region OCS. Onshore impacts from OCS exploration during this period have remained minimal at the two support bases serving the Mid-Atlantic Region.

1770 **(USGS-OFR—81-607) Outer Continental Shelf Oil and Gas Information Program: Gulf of Alaska and Lower Cook Inlet summary Report 2.** Collins, K.M.; Stadnychenko, A. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). Jun 1981. 55p. Geological Survey, 640 National Center, Reston, VA 22092. Order Number DE82900822.

The search for oil and gas on the Outer Continental Shelf (OCS) in the Gulf of Alaska subregion of the Alaska leasing Region began in 1967, when geophysical surveys of the area were initiated. Three lease sales have been held in the subregion. Lease Sale 39, for the northern Gulf of Alaska, was held on April 13, 1976, and resulted in the leasing of 76 tracts. Lease Sale CI, for Lower Cook Inlet, was held on October 27, 1977, and resulted in the leasing of 87 tracts. Lease Sale 55, held on October 21, 1980, resulted in the leasing of 35 tracts in the eastern Gulf of Alaska. Commercial amounts of hydrocarbons have not been found in any of the wells drilled in either the Sale 39 or Sale CI areas. As of February 1981, 75 of the 76 leases issued in the northern Gulf of Alaska have been relinquished, and 18 of the 87 CI leases have been relinquished. The next lease sale in the Gulf of Alaska, Sale RS-1 (a reoffering sale), is scheduled for late June 1981. Lease Sale 60 (Lower Cook Inlet and Shelikof Strait) is scheduled for September 1981. The most recent estimate by the US Geological Survey (USGS) of risked, economically recoverable resources for the one tract currently under lease in the northern Gulf of Alaska is that they are negligible. For the 35 tracts currently under lease (plus two tracts offered but not leased) in the northeastern Gulf of Alaska, the USGS has estimated risked, economically recoverable resource estimates of 12.6 million barrels of oil and 45.4 billion cubic feet of gas. Onshore impacts from OCS exploration in the Gulf of Alaska have been minimal. Two communities - Yakutat and Seward - served as support bases for past northern Gulf of Alaska exploration efforts. Kenai and Homer provided support for the exploratory drilling in Lower Cook Inlet. Yakutat will serve as the support base for Sale 55 exploration activities.

1771 **(USGS-OFR—81-619) Outer Continental Shelf oil and gas activities in the Mid-Atlantic and their onshore impacts: a summary report, November 1979. Update 3, August 1981.** McCord, C.A. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). 1981. 15p. Geological Survey, Office of OCS Information, 640 National Center, Reston, VA 22092. Order Number DE82900824.

At the present, there are no operators drilling in the Mid-Atlantic Region. The prime targets for future exploration will be in areas of 3000 to 6000 feet (914 to 1829 m) depth of water, seaward of previously leased tracts. No commercial discoveries have been found during the 4-year drilling history of the area. Because of the minimal offshore oil- and gas-related activity in the Mid-Atlantic Region, the onshore impacts are also minimal. Little development has occurred as a result of exploration or development. The level of nearshore and onshore activity may increase with exploration associated with upcoming Lease Sale 59. More permanent onshore development will be contingent on the outcome of future exploration efforts. After Lease Sale 59, the next sale is Lease Sale 76, which is tentatively scheduled for March 1983.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 2447, 2456, 2496, 2621, 2622, 2625

1772 **(NP—2900665) St. George Basin: draft environmental impact statement.** (Bureau of Land Management, Washington, DC (USA)). Oct 1981. 479p. Bureau of Land Management, Washington, DC . Order Number DE82900665.

This environmental impact statement examines a proposal for oil and gas leasing in St. George Basin, alternative to the proposal, major issues determined through the scoping process as well as staff analyses, and potential mitigating measures. The proposal consists of 479 blocks (approximately 2.7 million acres) which may be offered for lease in the St. George Basin, 61 to 179 miles offshore in water depths from 322 to 505 feet. All blocks offered some degree of pollution risk to the environment. The risk potential is related to adverse effects on the environment and other resource uses which may result principally from accidental or chronic oilspills. Socioeconomic effects from onshore development will have stage, regional, and local implications. Several alternatives and mitigating measures may be applied which would reduce the type, occurrence, and extent of adverse impacts associated with this proposal. Other measures, which are beyond the capability of this agency to apply, have also been identified. In spite of mitigating measures, some impacts are considered unavoidable. For instance, oilspills are considered statistically probable, some disturbance to fishery and wildlife values would occur, and some onshore development would occur in undeveloped areas. For each significant ecological resource, the probability of an oilspill impacting them has been given, based on an oilspill risk model.

1773 **(NP—2900825) Draft environmental impact statement: OCS proposed oil and gas lease sale 57, Norton Sound.** (Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office). Jun 1981. 383p. Bureau of Mines Land Management, Alaska OCS Office, P.O. Box 1159, Anchorage, AK 99510. Order Number DE82900825.

The environmental statement discusses a proposal for oil and gas leasing in Norton Sound, alternatives to the proposal, major issues determined through the scoping process as well as staff analyses, and potential mitigating measures. The proposal consists of 429 blocks (approximately 2.4 million acres) to be offered for lease in Norton Sound, 9 to 62 miles offshore in water depths from 16 to 167 feet. The probable impacts are based in part on the assumption that the mean resource estimate of 480 million barrels of oil would be discovered and produced in the proposed lease sale area. For this amount of oil, according to the USGS, 2.8 or about 3 oilspills exceeding 1000 barrels are probable over the 20-year production life of the oil field (Table IV.A.4.-1). There is only a 14 percent chance that commercial quantities of oil would be found. All blocks offered pose some degree of pollution risk to the environment. The risk potential is related to adverse effects on the environment and other resource uses which may result principally from accidental or chronic oilspills. Socioeconomic effects from onshore development will have state, regional, and local implications. Several alternatives and mitigating measures may be applied which would reduce the type, occurrence, and extent of adverse impacts associated with this proposal. Other measures, which are beyond the capability of this agency to apply, have also been identified. In spite of mitigating measures, some impacts are considered unavoidable. For instance, oilspills are considered statistically probable, some disturbance to fishery and wildlife values would occur, and some onshore development would occur in undeveloped areas. For each significant ecological resource, the probability of an oilspill impacting theme has,been given, based on an oilspill risk model.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 1757

03 Marketing And Economics

REFER ALSO TO CITATION(S) 1760, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 1768, 1769, 1770, 1771

0308 Environmental Effects

REFER ALSO TO CITATION(S) 1773

04 OIL SHALES AND TAR SANDS

0420 Regulations

1774 **(NP—2900666) Impact of the Clean Air Act on oil-shale development. API Oil-Shale Case Study Group.** (American Petroleum Inst., Washington, DC). 20 Aug 1981. 116p. American Petroleum Institute, Washington, DC. Order Number DE82900666.

This study examines the effects of existing and alternative Clean Air Act legislation on development of an oil shale industry in

the Piceance Basin of Colorado. The study concludes: (1) The Prevention of Significant Deterioration (PSD) increments of the Clean Air Act will limit the production of shale oil in the Piceance Basin to levels well below the resource potential. (2) If the PSD increments are eliminated, shale oil production could reach a level of about 800,000 barrels per day to be attained, instead of the 400,000 barrels per day that might be attained under the present law. (3) Visibility requirements in the present act may constrain production even further, but the predictive tools are, at present, inadequate to fully assess these effects. (4) The CAA requirements for the use of air dispersion models are a major technical weakness in assessing air impacts of Piceance Basin shale oil plants because no validated regional complex terrain models exist.

05 NUCLEAR FUELS

0501 Reserves

1775 **Reserves/grade relationships by type of uranium deposit. Key to strategies for securing future uranium supplies.** Douglas, H. (Hugh Douglas and Co. Ltd.). pp 86-91 of Uranium and nuclear energy 1980. Proceedings of the fifth international symposium held by the Uranium Institute, London, 2-4 September 1980. Guildford, England; Westbury House (1981).

From 5. international symposium on uranium and nuclear energy; London, UK (2 Sep 1980).

An analysis was made of the world's uranium deposits according to three factors: (1) grade, (2) quantity of reserves discovered, and (3) the type of uranium deposit. The objective of the research was to determine if there was a statistical correlation between these three factors that might provide clues to uranium exploration strategies and objectives. A study was made of 134 uranium deposits discovered since 1940; the 134 deposits include all economic uranium deposits that have been noted in the literature. The results are presented and discussed.

1776 **Uranium evaluation and mining techniques.** Vienna, Austria; IAEA (1980). vp. (CONF-7910245—).

From International symposium on uranium evaluation and mining techniques; Buenos Aires, Argentina (1 Oct 1979).

Separate abstracts are presented for each of the conference papers included in the data base.

0502 Exploration

1777 **Tectonic evolution of the continental crust of South America and its importance in the characterization of uraniferous provinces.** Cordani, U.G. (Sao Paulo Univ. (Brazzl)). pp 3-22 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981). (In Spanish)

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

The tectonic evolution of the South American Continent and its relationship with uranium mineralization is discussed. During the Phanerozoic at least three phases are identified as related to the Andean chain, namely, in the lower Palaeozoic, in the upper Palaeozoic and in the Meso-Cenozoic. Recent systematic age dating of the Precambrian indicates the period of 450-700 million years (m.y.) (Brazilian Cycle) as one of the most important tectonic events in South America. Another age-dating cluster corresponds to the 1700-2100 m.y. interval (Transamazonic Cycle). An even older event within the Archean is identified with datings older than 2600 m.y. in Venezuela (Estado Bolivar), Surinam and Brazil (Bahia, Santa Catarina, Goias). All the Brazilian uranium deposits related to the Brazilian platform, such as Amorinopolis, are located on the eastern border of the platform where the Brazilian tectonic cycle is dominant. The uranium source rocks are of alkaline granitic nature. Other deposits (Itataia, Campos Belos) are associated with polycyclic rocks belonging to the basement of the Brazilian Cycle but were affected by the 450-700 m.y. tectonic event; these amphibolitic facies rocks show alkaline metamorphism and magmatization processes which indicate large geochemical mobility during which important uranium mobilization has taken place. Finally, the Pocos de Caldas deposit is excellent evidence of the important relationship of tectonic reactivations and uranium enrichments within the Brazilian platform.

1778 **Permo-Triassic uranium deposits of Southern Africa within the African-South American Gondwana framework.** Toens, P.D.; Le Roux, J.P. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Geology Div.). pp 25-42 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981).

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

The discovery of uranium in the Permo-Triassic Gondwana in South America and Africa has served to highlight the intercontinental correlations. The purpose here is to examine the uranium deposits of Southern Africa in the light of the similarities that exist between the various Gondwana formations of the two continents. This hopefully will assist in gaining some understanding of the genesis of the uranium mineralization and the sedimentary environment in which such deposits are likely to occur. Between the Upper Carboniferous and the Jurassic a tectono-sedimentary terrain existed within Gondwanaland in which broadly similar conditions prevailed over large areas, thus producing numerous partly disconnected basins practically identical in character. The basal formations are composed of glacial tillite followed by a succession of sandstone and shale which attains a thickness of up to 12,000 m. Sedimentological studies confirm that major source areas composed largely of granitic and metamorphic rocks existed to the north and south of central South America and Southern Africa, as also in the divides between the basins. Uranium mineralization occurs sporadically throughout the succession and is usually restricted to palaeoriver channels containing carbon trash. There has been little subsequent enrichment and the Colorado model does not apply. With a few exceptions, the deposits tend to have a low overall uranium tenor and individual deposits are usually not very extensive in size. Collectively, however, they may eventually assume some importance. Uraniferous coals have been recorded from a number of localities and it is suggested that the significance of these deposits has as yet not been fully appreciated or investigated.

1779 **Gases in uranium exploration.** Wright, R.J.; Pacer, J.C. (Department of Energy, Washington, DC (USA)). pp 47-60 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981).

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

Interest continues to grow in the use of helium and radon detection as a uranium exploration tool because, in many instances, these radiogenic gases are the only indicators of deeply buried mineralization. The origin of these gases, their migration in the ground, the type of samples and measurement techniques are discussed. Case histories of comparative tests conducted on known uranium deposits at three geologically diverse sites in the United States of America are also presented.

1780 **High sensitivity airborne radiometric surveying over tropical and rain forest areas.** Richardson, K.A. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). pp 63-77 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981).

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

Two decades of research, development and application of high sensitivity airborne gamma-ray spectrometric surveying methods by the Geological Survey of Canada has led to the recognition and understanding of many factors which affect the compilation and interpretation of survey results in the Canadian environment. Some of these, as well as additional factors related particularly to

climate, weathering and vegetation in tropical regions, are briefly discussed. Notwithstanding the complications arising from gamma-ray attenuation by soil moisture and vegetation biomass, distortion of aircraft altimeter measurements by dense forest canopy, and redistribution of radioelements by weathering and vegetation, results of surveys from the Ivory Coast and Brazil indicate that airborne gamma-ray surveying can be beneficially applied to uranium exploration in tropical regions.

1781 **Geochemical orientation survey for uranium.** Grimbert, A. (CEA, 75 - Paris (France)). pp 79-87 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981). (In French)

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

Since it is not possible for all the emerged land and continental shelves to be covered by a general survey enabling the areas most favourable for the presence of uranium deposits to be pinpointed, there has to be a selection in order to establish priorities. Leaving aside economic and political considerations, this selection has so far been based on geological criteria that are very much open to subjective interpretation. To rectify this situation it is necessary to apply favourability characteristics that are specific and easy to measure, for example, the uranium content. To make a rapid assessment of the uraniferous nature of the geological formations that might be prospected, the geochemical prospecting methods should be based on the use of samples that are intercomparable, irrespective of the environmental conditions, while still being easy to take and to analyse. It is only monomineralic phases resistant to alteration that have a sufficiently stable composition for them to be intercompared under a wide variety of geological and climatic conditions. For convenience the choice has fallen on ilmenites, which are easy to sample in river sediments, are suitably resistant to alteration, have 'fixed uranium' contents ranging from 1 to 10 ppm, depending whether they come from 'sterile' or 'fertile' uranium areas, and are of a stable nature reflecting their formation medium or post-magmatic transformation. Ilmenites are likely to exhibit the properties required for their use in a geochemical orientation survey for uranium, but their effectiveness under all the conditions encountered has yet to be demonstrated. If they prove successful, they could make a useful contribution to the selection of regions where prospecting efforts could be concentrated on the basis of a rapidly established objective criterion and at very reasonable cost.

1782 **Two concepts of uranium geology in the United States of America that may be useful in Latin American uranium exploration.** Curry, D.L. (Department of Energy, Washington, DC (USA)). pp 89-103 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981).

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

Two concepts of the origin and deposition of uranium are described that are somewhat different from the conventional sandstone deposits of the United States of America. The first concept relates to granites as source and host rocks. Work done in the Granite Mountains of Wyoming provides considerable support for a granitic source. Calculations indicate that between 50 and 75% of the uranium has been leached from the granite to depths of nearly 400 m, and could have been source rocks for deposits in the Tertiary sandstones in adjacent basins. Areas of intense fracturing are also hosts for redeposition and concentration of uranium in granites of the Granite Mountains. The second concept describes resurgent cauldrons as source and host rocks. The development of resurgent cauldrons provides a variety of geological settings favourable for both intra-caldera deposits and deposits forming in adjacent basins. A collapsed caldera may contain a lake into which sediments from ejected material carrying uranium could be carried and into which direct contributions of uranium could come from the underlying magma. Weathering of uranium-bearing material deposited outside the caldera could provide uranium to be redeposited in conventional deposits such as roll fronts. Geological investigations carried out in the Great Basins of Utah and Nevada are cited.

1783 **Aerial, land-based and drilling techniques for uranium exploration.** Baird, J.G.; Seara, J.L. (Scintrex Ltd., Concord, Ontario (Canada)). pp 105-115 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981). (In Spanish)

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

Radiometric methods of uranium prospecting have acquired great importance on account of the high demand for uranium as power reactor fuel and the possibility of their use for geological and structural studies. The concentration of uranium in the deposits is generally of the order of 0.1% or less. Such a low concentration may go undetected by the geologist's magnifying glass when examining the samples. Fortunately, uranium and its decay products emit gamma rays which can be detected by special instruments. Described here, for the benefit of the field geologist using such instruments, are the basic concepts and applications of the different types of instrumentation for the detection and analysis of potassium, uranium and thorium concentrations from aircraft, vehicles and boats, by borehole logging and in outcrops and laboratory samples.

1784 **Uranium exploration techniques in Bolivia.** Virreira, V. (Comision Boliviana de Energia Nuclear (COBOEN), La Paz). pp 117-122 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981). (In Spanish)

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

The exploration techniques used by the Bolivian Nuclear Energy Commission/Comision Boliviana de Energia Nuclear (COBOEN) in certain areas of Bolivia that are considered promising from the standpoint of uranium deposits are presented in summary form. The methods and results obtained are described, including the techniques used by the Italian company AGIP-URANIUM during four years of exploration under contract with COBOEN. Statistical data are also given explaining the present level of uranium exploration in Bolivia.

1785 **Cost-effective geophysical survey systems for uranium exploration.** Hasbrouck, J.C. (GeoMetrics, Inc., Sunnyvale, CA (USA)). pp 123-128 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981).

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

When planning a uranium exploration survey the question always arises as to how to take advantage of the different exploration methods and equipment for maximum probability of success. Discussed here are the choice of radiometric geophysical equipment, its effectiveness in identifying targets, its limitations, and the criteria for selection. Particular attention is given to systems that are suitable for the exploration programmes of small size and on a small budget, that are common in Latin America.

1786 **Indirect methods of uranium prospecting by NUCLEBRAS.** Da Vinha, C.A. (NUCLEBRAS (DRM), Fortaleza, Brazil). pp 129-150 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981). (In Spanish)

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

The implementation of the Brazilian nuclear programme required a clear definition of the availability of uranium resources in the country. To carry out this mission the Department of Mineral Resources (DRM) - NUCLEBRAS, in the last four years, developed and applied an exploration system for area selection, anomaly prospecting and resources evaluation. In all these exploration phases indirect methods are used, mainly aerial and ground geophysical surveys, remote sensing, geochemical surveys and bore-

hole logging. Described here are the exploration methodology used by the DRM, the conditions of this application and the results obtained in different geological environments.

1787 **Determination of favorable areas for uranium prospecting in Bolivia.** Pardo, E. (Dept. de Materias Primas, Comision Boliviana de Energia Nuclear (COBOEN), La Paz). pp 155-176 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981). (In Spanish)

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

The most prominent geological, lithological, stratigraphic, orogenic, metallogenetic, palaeogeographic and geochemical features favourable for the concentration of uranium deposits in Bolivia are described. This is a generalized study of the features mentioned above and should provide guidelines for eventual better understanding of the geology of Bolivia in general and that of uranium in particular. The purpose here is to demonstrate rational planning, which should be followed by the determination of favourable areas for uranium exploration, by the Bolivian Nuclear Energy Commission/Comision Boliviana de Energia Nuclear (COBOEN), and to provide basic information for the drawing up of contracts with foreign and/or national organizations interested in investing in uranium exploration.

1788 **Uranium exploration in Ecuador.** Severne, B. (International Atomic Energy Agency, Vienna, (Austria)); Penaherrera, P.F.; Fiallos, V.S. (Comision Ecuatoriana de Energia Atomica, Quito). pp 179-189 of Uranium deposits in Latin America: Geology and exploration. Proceedings of a regional advisory group meeting organized by the IAEA and held in Lima, Peru, from 4 to 8 December 1978. Vienna, Austria; IAEA (1981).

From IAEA advisory group meeting on uranium deposits in Latin America: geology and exploration; Lima, Peru (4 Dec 1978).

The 600-km segment of the Andean Cordillera in Ecuador includes zones that can be correlated, geologically, with uranium districts elsewhere in the Andes. It is believed that these essentially unexplored zones have the potential for economic uranium mineralization. Exploration activity to date has been limited, although it has involved both geochemical and radiometric techniques to evaluate geological concepts. Minor uranium occurrences (with chemical analyses up to 100 ppm) have been encountered, which provide further incentive to commence large-scale systematic exploration. It is recognized that a very large exploration budget and considerable technical expertise will be required to ensure exploration success. Consequently, participation by groups of proven capability from other countries will be sought for Ecuador's national exploration programme.

0503 Mining

REFER ALSO TO CITATION(S) 1776

0504 Feed Processing

1789 **Uranium extraction from solutions at ground and in-mine sorption plants of underground leaching zones.** Vodolazov, L.I.; Veselova, L.N.; Nesterov, Yu.V. pp 160-183 of Uranium output by underground leaching. Mamilov, V.A. (ed.). Moscow, USSR; Atomizdat (1980). (In Russian)

The problems of uranium ionic state in solutions, mixtures accompanying uranium, the main regularities of statics and dynamics of sorption reprocessing are considered in detail. The diagrams and types of apparatus of sorption reprocessing of both periodic and continuous actions are presented, alongside with the principle flowsheet of the process. Some foreign ground complexes of sorption reprocessing of underground leaching solutions are considered.

1790 **Physicochemical bases of underground leaching process.** Nosov, V.D.; Nesterov, Yu.V.; Sadykov, R.Kh. pp 78-106 of Uranium output by underground leaching. Mamilov, V.A. (ed.). Moscow, USSR; Atomizdat (1980). (In Russian)

Physicochemical bases of uranium underground leaching (UL) from ores are considered. The UL process is generally characterized. Advantages and disadvantages of acidic and carbonate leaching techniques are discussed. UO_2 oxidation and solution using oxygen and MnO_2 as oxidizers in the presence of $^{3+}$ Fe catalysts and nitrogen oxides, are considered. The data on the solvent interaction with ore and enclosing rock components are given. The mechanisms and kinetic regularities of extracting uranium from ores with natural and artificial permeability are described as well as the mechanisms and kinetic regularities of the process of dissolved uranium absorption by ore-free rocks.

0507 Fuels Production And Properties

1791 (EUR—6813(Vol.1), pp 674-676) **Fuel dosimetry. Session I. Review presented at the third ASTM-Euratom symposium on reactor dosimetry.** Mas, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1980. (In French). Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Dosimetry of nuclear fuels include an important part of fuel cycle: new fuels, spent fuels, storage, transport, burnup. Computer codes are frequently used. Adjustments based on experiments are regularly undertaken. Accuracy is specific of each application. A brief survey of papers presented is given.

1792 (EUR—6813(Vol.2), pp 819-838) **Applications of the gamma spectrometry to the study of a plate fuel.** Carteret, Y.; Schley, R.; Simonet, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1980. (In French). Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

The experimental irradiation programme carried out at the CEA on CARAMEL plate fuel was followed by gamma spectrometry in conjunction with other techniques. The qualitative study of the distribution of fission products constitutes a source of information on fuel behaviour (temperature and structure) and enables its utilization limits to be predicted. The quantitative determination of short and long half life fission products enables the specific power and specific burn-up to be calculated. This is carried out periodically and is a means of checking the values obtained by the continuous monitoring of cladding temperatures, directly linked to the specific power. At the end of irradiation, the results are compared with those obtained by neodymium analysis.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 1797, 2400

1793 (EUR—6629, pp 49-69) **On-line instrumentation for process monitoring in the German reprocessing plant.** Schultes, E.; Finsterwalder, L. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)). 1979. (In German). Dep. NTIS (US Sales Only).

From International meeting on monitoring of Pu-contaminated waste; Ispra, Italy (25 Sep 1979).

Reprocessing and waste treatment can be carried out more economically by using on-line monitors. This because activity inventory, the amount of rework and necessary laboratory facilities can all be reduced, due to a proven instrumentation designed into the plant. However not sufficient proven instruments are available in the FRG. Some important reasons why this is so, will be discussed. Future work should be directed towards establishing proven monitors. This paper explains the special requirements for on-line instruments for plutonium-bearing process streams. For this purpose the specifications for on-line instruments are discussed from both safety and operational aspects using preliminary process flow-

sheets of the planned German Reprocessing Plant (NEZ) in Gorleben.

1794 **Fuel reprocessing and waste disposal.** Allday, C. (British Nuclear Fuels Ltd., London). pp 40-49 of Energy Australia 1979. Papers presented on the occasion of the Diamond Jubilee Conference of the Institution of Engineers, Australia, held in Perth, 31st March to 6th April, 1979. Endersbee, L.A. (ed.). Perth, Australia; Institution of Engineers, Australia (1979).

From Diamond jubilee conference of the institution of engineers; Perth, Australia (31 Mar 1979).

The present position in the reprocessing and waste management industries is reviewed. Benefits to be derived from reprocessing are discussed and areas where further development is being, or will need to be done, particularly with regard to reducing radioactive discharges to the environment and radiation exposure to personnel are considered. The problems with solid waste treatment and with the disposal of highly active liquid wastes are outlined.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 1804

0510 Marketing And Economics

1795 **Uranium royalties and severance taxes in the Grants Region, with examples of their effects on minimum producible grade.** Melvin, J.W. (Wood and Griswold, Inc., Albuquerque, NM). *Memoir - New Mexico Bureau of Mineral Resources;* No. 38, 334-339(1980). (CONF-7905120—).

From New Mexico Bureau of Mines and Mineral Resources conference; Albuquerque, NM, USA (13 May 1979).

Royalty agreements include devices by which unit amounts vary with grade and with U_3O_8 sale price. Eight actual agreements yield $3.63 to $9.16 per lb of recovered U_3O_8 (mean = $5.60), if the average grade is 0.181 percent U_3O_8 and the sale price is late 1978 spot quote of $43.00 per lb. If the sale price is the average 1978 delivery price of $17.40 per lb, the same-grade royalty amounts are $1.12 to $2.76 per lb (mean = $1.69). Severance taxes vary with sale price, typically amounting to $2.81 per lb U_3O_8 sold at $43.00 and to $0.62 per lb sold at $17.40. Calculations using a realistic, average mining situation indicate that at the $43.00 price, a minimum producible grade of 0.110 percent U_3O_8 when royalties and severance taxes amount to $7.07 per lb increases to 0.120 percent U_3O_8 if combined royalties and severance taxes increase to $10.06 per lb, and the minimum grade decreases to 0.100 percent U_3O_8 if royalties and severance taxes decrease to $3.48 per pound. Applying these effects to a real and typical uranium deposit of modest size reveals that if minimum grade must be increased from 0.110 percent to 0.120 percent U_3O_8, the value of the lost U_3O_8 (at $43.00 per lb recoverable) is $16.5 million more than the revenue gained by the higher royalty and taxes. If minimum grade can be decreased from 0.110 percent to 0.100 percent U_3O_8, the value of the U_3O_8 gained exceeds by almost $10.9 million the amount of revenue lost by the lower royalty and taxes. Extrapolation suggests that the economic conseuqences for New Mexico amount to billions of dollars.

0520 Waste Management

REFER ALSO TO CITATION(S) 1793, 1794, 1803, 2170, 2171, 2173, 2239

1796 (EUR—6629, pp 15-27) **Control of Pu-contaminated wastes. Necessity and method.** Sousselier, Y.; Pottier, P. (CEA, 75 - Paris (France)). 1979. (In French). Dep. NTIS (US Sales Only).

From International meeting on monitoring of Pu-contaminated waste; Ispra, Italy (25 Sep 1979).

The importance of the problems raised by wastes containing plutonium is growing fast with the expansion of electro-nuclear programmes. Plutonium is not a waste substance, its reuse (reprocessing - mixed oxide fuel cycles) considerably restricts the mass of plutonium to be stored with the wastes. The optimized control of waste has to take into account the constraints linked to definitive storage (level of transuranium elements and containment capacity of sites) as well as the economic limits of plutonium retrieval from wastes. The presence of growing quantities and concentrations of transuranium elements increases the complexity of this control. The control of wastes is an absolute necessity for reasons of safety, for the economics of the system and the technical management of wastes. Since the control methods can be cross checked, if needs be, and compared with the inventory of substances they must be: sure (results independent of the physical-chemical form of the packaging, etc), simple to use, and with a sensitivity and accuracy matched to requirements, particularly as regards the minimum detection level.

1797 (EUR—6629, pp 29-48) **Integrated solid waste measurement system for plutonium fuel reprocessing at Dounreay Nuclear Power Development Establishment.** Bremner, W.B.; Macleod, K.C. (UKAEA Dounreay Nuclear Power Development Establishment). 1979. Dep. NTIS (US Sales Only).

From International meeting on monitoring of Pu-contaminated waste; Ispra, Italy (25 Sep 1979).

A wide range of solid waste materials of varying α, β and γ activity will be produced at the Dounreay Nuclear Power Development Establishment (DNPDE) from reprocessing and post irradiation examination of irradiated fuel from the Prototype Fast Reactor. Disposal and storage requirements for these wastes are determined by the level and type of radioactive species present. An integrated waste management system has been designed and commissioned which can meet the authorised disposal limits or relative storage category and which can also comply with fissile material accountancy, criticality and plant operational control. The basic criteria which were used to ensure safe disposal or storage of these were, firstly that all wastes will be retained within the site boundary and secondly that waste will be segregated according to the level of activity present and, if greater than 20 milli Ci of α activity per M^3 (after 100 years storage), will be stored in a manner which will allow retrieval for further treatment. Theses criteria led to two basic measurement requirements: (i) Measurement for sentencing of waste where the plutonium level is very low (of the order of a few milligrams) and therefore a sensitive but relatively imprecise technique is acceptable. (ii) Measurement for accountancy, criticality, plant control and safeguards where the levels of plutonium present require precise measurement prior to retrievable storage. No individual technique can meet these requirements for all of the waste categories envisaged and thus an integrated system was designed which comprises ten non-destructive analysis facilities. For sentencing of waste the preferred approach is passive neutron counting while for accountancy gamma emission or neutron interrogation are used, depending on the density and the associated gamma activity.

1798 (INIS-mf—6528, pp 4-7) **Investigations of the contamination and decontamination of stainless steel samples.** Badacsonyi, T.; Maleczki, E.; Ujhidy, A.; Varga, I. (Veszpremi Vegyipari Egyetem (Hungary). Radiokemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The adsoprtion of ^{128}I and ^{85}Sr and the decontamination efficiency of various agents have been tested on stainless steel samples. Radioactive preparations with and without carrier material have been used. The sorption factors have been used to determine the extent of contamination obtained by dipping the sample into the solutions. The decontamination factors and the percentage of the remaining activity values have been used to characterize the efficiency of the various decontaminating agents.

1799 (NLCO—006EV) **Phase I remedial action of properties associated with the former Middlesex Sampling Plant site.** Boyer, J.W.; Adair, N.D.; Poff, T.A.; Brown, J.A.; Kispert, R.C.; Cavendish, J.H.; Heareth, H.C. (National Lead Co. of Ohio, Cincinnati (USA)). Sep 1981. Contract AC05-76OR01156. 161p. NTIS, PC A08/MF A01. Order Number DE82000929.

The Phase I Remedial Action Work was successfully completed during 1980 at the Middlesex Sampling Plant. In addition to the two properties included in the original scope of work, three

other properties were decontaminated. In the playground across the street from the Rectory, contaminated soil was discovered and subsequently removed. Later, at the request of the DOE, the Kays and Rosamilia properties were decontaminated. Work completed at Middlesex, together with the lessons learned during the execution of the entire project, is indicative that future decontamination assignments can be accomplished with mutual benefits for the DOE, as well as the local citizens. Restoration of the Rectory and the William Street property exemplifies the excellence of work performed by the Remedial Action Subcontractors and is further evidence of the success of the Phase I work. A summary of the Phase I costs are tabulated. A report is presented on the tasks performed.

1800 **Corrosion testing of candidate canister materials with alternative waste forms.** Mack, J.E.; Lackey, W.J.; Angelini, P.; McCoy, H.E. (Oak Ridge National Lab., TN (USA)). *Transactions, Annual Conference - Canadian Nuclear Society;* **1**: 60-61(1980).

From Canadian Nuclear Society annual conference; Montreal, Canada (18 Jun 1980).

1801 **Immobilization of high-level nuclear reactor wastes in SYNROC.** Ringwood, A. (Australian National Univ., Canberra. Research School of Earth Sciences). pp L 51 of Energy sources - Australia's needs. Vol. 2. Proceedings of the Australian Institute of Energy First National Conference, held in Newcastle on 5 - 9 February 1979. Namisnyk, M. (ed.). Newcastle, Australia; Australian Institute of Energy (1979).

From 1. national conference of the Australian Institute of Energy; Newcastle, Australia (5 Feb 1979).

1802 **Safe immobilization of high-level nuclear reactor wastes.** Ringwood, A.; Kesson, S.; Ware, N.; Hibberson, W.; Major, A. (Australian National Univ., Canberra. Research School of Earth Sciences). pp 71-98 of Scientific advances and community risk. Proceedings of a meeting of the Science and Industry Forum of the Australian Academy of Science, held on 6 - 7 October 1978. White, F. (ed.). Canberra, Australia; Australian Academy of Science (1979).

From Meeting of the science and industry forum of the Australian Academy of Science; Canberra, Australia (6 Oct 1978).

The advantages and disadvantages of methods of immobilizing high-level radioactive wastes are discussed. Problems include the devitrification of glasses and the occurrence of radiation damage. An alternative method of radioctive waste immobilization is described in which the waste is incorporated in the constituent minerals of a synthetic rock, Synroc. Synroc is immune from devitrification and is composed of phases which possess crystal structures identical to those of minerals which are known to have retained radioactive elements in geological environments at elevated pressures and tempertures for long periods. The composition and mineralogy of Synroc is given and the process of immobilizing wastes in Synroc is described. Accelerated leaching tests at elevated pressures and temperatures are also described.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 2497

1803 **(PNL—3877) Simulation of water flow and retention in earthen-cover materials overlying uranium mill tailings.** Simmons, C.S.; Gee, G.W. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 102p. (UMT—0203). NTIS, PC A06/MF A01. Order Number DE82000239.

The water retention characteristics of a multilayer earthen cover for uranium mill tailings were simulated under arid weather conditions common to Grand Junction, Colorado. The multilayer system described in this report consists of a layer of wet clay/gravel (radon barrier), which is separated from a surface covering of fill soil by a washed rock material used as a capillary barrier. The capillary barrier is designed to prevent the upward migration of water and salt from the tailings to the soil surface and subsequent loss of water from the wet clay. The flow model, UNSATV, described in this report uses hydraulic properties of the layered materials and historical climatic data for two years (1976 and 1979) to simulate long-term hydrologic response of the multilayer system. Application of this model to simulate the processes of infiltration, evaporation and drainage is described in detail. Simulations over a trial period of one relatively wet and two dry years indicated that the clay-gravel layer remained near saturation, and hence, that the layer was an effective radon barrier. Estimates show that the clay-gravel layer would not dry out (i.e., revert to drying dominated by isothermal vapor-flow conditions) for at least 20 years, provided that the modeled dry-climate period continues.

1804 **Environmental impact of transporting radioactive materials.** Chicken, J.C. (UKAEA Culham Lab., Abingdon); Goldfinch, E. (Central Electricity Generating Board, London (UK)); Milne, W. G. (British Nuclear Fuels Ltd., Risley). pp 187-214 of Environmental impact of nuclear power. Proceedings of a conference organized by the British Nuclear Energy Society, and supported by the UK Atomic Energy Authority, held in London on 1-2 April, 1981. London, England; British Nuclear Energy Society (1981).

From Conference on the environmental impact of nuclear power; London, UK (1 Apr 1981).

This paper gives the authors' perception of the environmental criteria that the transport of radioactive material operations have to satisfy in the United Kingdom. In building up this picture the basis of the regulations that have to be satisfied are described and the way these regulations are complied with discussed. A summary of transport operational experience is given. Finally, the range of risk studies that have been done to cover individual and collective dose possibilities, the loss of a flask at sea, accident frequency, and an example of risk evaluation for a specific movement is given.

0540 Health And Safety

REFER ALSO TO CITATION(S) 2560

1805 **Criticality safety training at a fuel examination facility.** Courtney, J.C. (Louisiana State Univ., Baton Rouge (USA). Nuclear Science Center); Thelen, V.N. (Argonne National Lab., IL (USA)). *Health Physics;* **40**: No. 5, 729-731(May 1981).

A multimedia training program in criticality safety has been developed for fissile-material handlers who work at the Hot Fuel Examination Facility (HFEF) complex at Argonne National Laboratory. The training program consists of a course in the basic theory of nuclear criticality to give employees an understanding of the reasons for the specific rules for handling fissile materials. Successful completion of written tests on the theory of criticality and the specific rules is a prerequisite to entering the on-the-job training phase. Continual training and recertification requirements help to keep personnel aware of the importance of safety.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 1939

0702 Radiation Sources

REFER ALSO TO CITATION(S) 2361

1806 **(IA—1356, pp 313-314) Production of sealed neutron-sources.** Dahan, D.S.; Pasi, M. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

1807 (INIS-mf—6528, pp 213-216) **Experiences of the engineering application of radioisotopes.** Rona, V. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The paper studies the experiences gained during some engineering applications of radioisotopes, namely (i) the correction determination of specific counting rates related to equal volumes of the samples, (ii) the simultaneous application of the constant rate injection and the total count method during flow rate mesurements, (iii) the possibilities of the reduction of errors in the process of concentration determinations in ternary systems using ^{241}Am and ^{137}Cs sources.

1808 (INIS-mf—6528, pp 159-162) **X-ray sources with Promethium-147 isotope for XRF analytical purposes.** Mangliar, F.; Kiraly, J. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The paper deals with the description and testing of a new X-ray source applying ^{147}Pu isotope and various target materials for X-ray fluorescence (XRF) analytical purposes. Good quality energy spectra were recorded in case of Fe, As, Zr, Cd, Ce targets. The sources can be applied in industrial laboratories, too.

1809 (INIS-mf—6528, pp 78-83) **Generalization of the normal distribution for the description of particle velocity distribution measured by radioindication method in different fluidized systems.** Hodany, L. (Koezponti Fizikai Kutato Intezet, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A new method has been developed on the basis of possible dynamic equilibrium states in different fluidized systems. For the description of the particle velocity distribution the generalized form of the normal distribution was used.

1810 **Definition of the activation level energy of nuclear isomers by the calibration method of microspectra by means of different radioactive sources.** Veresh, A.; Pavlichek, I. pp 283-284 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

A method for calibrating microspectra is proposed to determine the energy of the activation levels of nuclear isomers. The essence of the method is in experimental es--timating of the number of γ quanta scattered on a given level for two or more different γ sources with the aid of an isomer with a known energy of activation level excitation. The sample studied is then irradiated, and the integrated cross section is calculated for various energies by the measured isomer activity. This method was used to determine the energy of the ^{195}Pt activation level. It is equal to 118U keV at the error of +-10 keV. ^{60}Co and ^{182}Ta were used as radioactive γ sources, and the 1078 keV level of ^{115}In served as the calibration isomer. The life time of the ^{195}Pt level of 1180 keV equalled $2.7x10^{-13}$ s.

08 HYDROGEN

0802 Storage

1811 **High voltage electron microscopy of hydrogen dissolution in FeTi^{+}.** Pande, C.S. (Brookhaven National Lab., Upton, NY); Lyles, R.L. Jr.; Pick, M.A. pp v of 37th annual proceedings Electron Microscopy Society of America. Bailey, G.W. (ed.). San Antonio, TX; Electron Microscopy Society of America (1979).

Electron microscopic studies of hydrided samples of FeTi indicated that hydriding times of <1 min resulted in predominately solid solution of H in FeTi (α-phase). Longer hydriding times resulted in specimens in the two phase region ($\alpha + \beta$). In the β-phase, the H atoms were found to be ordered, and the diffraction pattern exhibited superstructure reflections. Some other features of the electron micrographs are noted. (BLM)

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

1812 **(DOE/CS/83004—1) Development of hydroconversion of biomass to synthetic fuels. Project 61042 technical progress report, May 16-Sep 30, 1980.** (Institute of Gas Technology, Chicago, IL (USA)). Dec 1980. Contract AC02-80CS83004. 57p. NTIS, PC A03/MF A01. Order Number DE82000874.

The objective of this program is to develop the hydroconversion (in-situ production and addition of hydrogen to carbonaceous species) of biomass (forest and crop residues) to produce substitute natural gas. The program will also include experiments to investigate the production of hydrocarbon liquids from biomass. Progress made during the first reporting period is reported. A list of recent biomass survey and availability literature was compiled; samples of wood materials were obtained for characterization, handling, and bench-scale testing. Standard chemical and physical tests for biomass materials were identified for use in characterizing each material and its char in the program. The initial analysis and testing began with a sample of Douglas fir hog fuel. Bench-scale hydrodevolatilization and char gasification tests were performed. Experiments with maple hardwood chips are in progress. A detailed report describing the process development unit (PDU) design was submitted to DOE fs likely that particular energy policies will be incorporated into one of the two major dimensions of attitudes and experience, both negative, and opposed accordingly. Policymakers face a challenging situation that could be alleviated only if voters develop a coherent, integrated body of thought on energy issues. 18 references, 4 tables, 5 notes.

0902 Alcohol Fuels

1813 **(NYSERDA—81-3) Ethanol production in Suffolk County, New York: technical and economic feasibility. Final report.** (Cornell Univ., Ithaca, NY (USA); Cornell Univ., Geneva, NY (USA). Dept. of Food Science and Technology). Sep 1981. 194p. New State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number DE82900937.

An investigation was conducted to determine the technical and economic feasibility of developing an ethanol conversion facility within Suffolk County, New York. Two plant designs of 25 million gallons and 50 million gallons of annual production capacity are studied. Corn is selected over other potential feedstocks due to its availability throughout the year, and its lower cost even after transportation from remote locations is considered. Uncertainty is simulated by incorporating random fluctuations in feedstocks costs and by-product prices directly into the analyses, and by systematically varying key assumptions. Uncertainty with respect to expected outcomes is measured as variability about an expected after tax net present value (ATNPV). Given the base assumptions, variability about the expected ATNPV is substantial enough to lead to a four percent chance of unprofitable development for the 25 million gallon plant, and a one percent chance for the 50 million gallon plant. Uncertainty from systematic changes in parameters is measured by comparing individual cases against a base assumptions case. ATNPV is quite sensitive to the transportation cost of inputs, feedstock and ethanol prices, debt-equity ratios, commercial loan rates, and rates of return on equity. A pessimistic divergence from the base assumptions on any one of these parameters would seriously impair plant feasibility. One critical aspect, for instance, is the future price trend of ethanol. Only under an assumed real rate of price increase of 1 percent or more annually will be expected ATNPV be positive for either plant, while a rate of 5 percent or above is required to insure plant feasibility against all factors of incorporated uncertainty.

13 HYDRO ENERGY

1301 Resources And Availability

1814 (INIS-mf—6285, pp 85-91) **Review on the function of water energy nearly the year of 2000.** Notodihardjo, M. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Review of water power and comparative evaluation between pumped storage plant and nuclear power plant are presented.

1303 Plant Design And Operation

1815 **(NYSERDA—81-16) Modular small hydro configuration.** (Fraser (J.Kenneth) and Associates, Rensselaer, NY (USA)). Sep 1981. 191p. New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number DE82900942.

The Modular Small Hydro Configuration has been conceived and structured to address a selected fraction of the overall hydropower development market. In particular, smaller sites - those under 750 kilowatts, which previously were not attractive to develop using equipment intended for application at larger scale sites, have been the focal point in the conception of this system. This system utilizes standard industrial components which are generally available within short procurement times. Such components have been integrated into a development scheme for sites having 20 feet to 150 feet of head. The Modular Small Hydro Configuration maximizes the use of available components and minimizes modification of existing civil works. A key aspect of the development concept is the use of a vertical turbine multi-stage pump, used in the reverse mode as a hydraulic turbine. The configuration allows for automated operation and control of the hydroelectric facilities with sufficient flexibility for inclusion of potential hydroelectric sites into dispersed storage and generation (DSG) utility grid systems. The Modular Small Hydro Configuration provides an additional tool to the hydroelectric engineer for development of this significant renewable energy resource.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 2085

1816 **(TAC-SPG—81-003) Solar-power generation: a bibliography with abstracts. Quarterly update July-September 1981.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Nov 1981. 208p. University of New Mexico, Technology Application Center, Albuquerque, New Mexico 87131. Order Number DE82901063.

This annotated bibliography covers the following aspects of solar power: energy overviews; solar overviews; energy conservation; environmental, health, and safety; economics, law, and policy; total energy, hybrid, and combined systems; solar thermal power and heliostats; thermoelectric, thermionic, and thermochemical; OTEC, ocean kinetic, and osmotic energy; wind energy; biomass, biofuels, and photochemical; and energy storage, hydrogen. (MHR)

1403 Economics

REFER ALSO TO CITATION(S) 1823, 1824

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 1829

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 1812, 1813, 1861, 2150, 2165

1817 **(DOE/ET/20556—T1) Thin film polycrystalline silicon solar cells. Quarterly report No. 2, 1 January 1979-30 March 1979.** Sarma, K.R.; Rice, M.J.; Legge, R.; Ramsey, W.C. (Motorola, Inc., Phoenix, AZ (USA). Solar Energy Dept.). 1979. Contract AC03-78ET20556. 35p. NTIS, PC A03/MF A01. Order Number DE81024348.

A composite substrate concept was developed and shear separation successfully demonstrated. This substrate consists of a main molybdenum substrate, a thin (1 μm) SiO_2 barrier layer and a thin (3000A) Mo layer. The thin Mo layer gets coverted to $MoSi_2$ and acts as a shear separation layer. This composite substrate shows promise for substantial improvement in recyclability and the quality of silicon ribbons produced. Effects of $SiHCl_3$ concentration, total reactant flow rate, beam RF power, substrate temperature and gravity on energy beam deposition were investigated. The deposition efficiency was found to be a strong function of input chlorosilane concentration. Rotating nozzle deposition was also studied. Problems were encountered in the use of the rotating nozzle due to improper impedance matching with the nozzle assembly. This required redesign of the rotating assembly to improve impedance matching. EBD silicon ribbons were grain enhanced by RTR recrystallization and successfully gettered by a two sided phosphorous diffusion which resulted in diffusion lengths ranging up to 75 um. Solar cells, 1 x 2 cm in area were fabricated on these silicon ribbons; they exhibited conversion efficiencies of up to 10.1% with a V/sub OC/ of 0.54V, J/sub of 29.5 mA/cm/ and a FF of 63%.

1818 **(TAC/SP—81-003) Solar photovoltaics: a bibliography with abstracts. Quarterly update, July-September 1981.** Sparkman, T.; Bozman, W.R. (eds.). (New Mexico Univ., Albuquerque (USA). Technology Application Center). Nov 1981. 164p. Univ. of New Mexico, Albuquerque, NM 87131. Order Number DE82901061.

This annotated bibliography covers: overviews, economics and policy concerning solar photovoltaics; legal, environmental, health and safety aspects; solar cell materials, materials properties and encapsulants; cell fabrication and configuration; performance, testing, simulation and evaluation; module and array types, fabrication and performance; applications and complemental hardware; energy storage; and solar satellite power systems. An author index and keyword index are included. (LEW)

1819 **Heavy-doping effects in silicon: the role of Auger processes.** Redfield, D. (RCA Labs., Princeton, NJ). *Solar Cells;* **3**: No. 4, 313-326(Jul 1981). Contract AC01-79ET23108.

A review is presented of heavy-doping effects in silicon, of the important role of Auger recombination in silicon solar cells and of the competing band-gap-narrowing model of heavy-doping effects. It is shown that previous analyses of these effects in silicon solar cells failed to include properly the consequences of Auger processes. By the use of a new method of calculating the saturation current of a p-n junction that incorporates Auger effects, it is found that this current is rather insensitive to doping density in the regime of heavy dopings. A wide variety of experiments are described that have led to interpretation by band gap narrowing. A critique of several of these interpretations is presented that disputes most quantitative estimates of such narrowing. A brief discussion of theories of band gap narrowing is also concluded with similar doubt about past estimates.

1820 **Study of gap states in a—Si:H alloys by measurements of photoconductivity and spectral response of MIS solar cells.** Vanier, P.E.; Delahoy, A.E.; Griffith, R.W. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **73**: No. 1, 227-232(Jun 1981). (CONF-810331—).

From Conference on tetrahedrally bonded amorphous semiconductors; Carefree, AZ, USA (12 Mar 1981).

A picture of the density of gap states n (E) in glow discharge a—Si:H is constructed using four different kinds of transport measurement on a large number of samples. The minimum in n (E)

lies 0.4 eV below E/sub c/, rather than in the middle of the gap. A distribution of fast recombination centers lies at mid-gap, and two sets of hole traps lie between mid-gap and the valence band. Modifications in n (E) have been studied by the effects of selected impurities on the conversion efficiency and spectral response of MIS and pin solar cells.

1821 **Interfacial phenomena in solar materials.** Murr, L.E. (Oregon Graduate Center, Beaverton). *Solar Energy Materials;* **5**: No. 1, 1-19(Jun 1981). Contract FG04-79AL10887.

The fundamental features of the general classes of interfaces and interfacial thermodynamics are briefly reviewed. The energetics and structures of interfaces are reviewed in the context of applications of current understanding of interfacial phenomena to specific materials in several solar technologies. Overviews are presented for interfacial energetics, compositional and chemical analysis of interfaces, and the structure of interfaces and representative illustrations are provided. Numerous examples of interfacial phenomena pertinent to solar materials interface problems are included, and solar materials interface problems are discussed and summarized in a general way. Problems or concerns are tabulated for interfaces in specific solar systems or components, e.g., reflectors, polymers, absorbers, collectors, PV cells, storage systems and heat transfer materials.

1822 **Simplified flashlamp technique for solar cell series resistance measurements.** Cape, J.A. (Rockwell International Electronics Research Center, Thousand Oaks, CA); Oliver, J.R.; Chaffin, R.J. *Solar Cells;* **3**: No. 3, 215-219(May 1981). Contract AC04-76DP00789.

It is shown that the effective series resistance of a solar cell can be measured easily and accurately by the following simple technique. Two successive pulses (about 1 ms) of equal intensity from a high intensity flashlamp are used to measure first the open-circuit voltage V/sub oc/ and secondly the voltage V/sub L/ across a small known series load resistance R/sub L/. It is shown that to excellent accuracy the series resistance can then be computed from the formula R/sub s/ = R/sub L/(V/sub oc//V/sub L/ - 1). The technique offers the convenience that the cell does not require heat sinking and problems of temperature variation are obviated.

1823 **Economic analysis of photoelectrochemical cells.** Weaver, N.L.; Singh, R.; Rajeshwar, K.; Singh, P.; Dubow, J. (Colorado State Univ., Fort Collins). *Solar Cells;* **3**: No. 3, 221-232(May 1981). Contract XP-9-8002-9.

The economic viability of photoelectrochemical cells is examined for two representative systems based on n-type GaAs and n-type CdSe electrodes in contact with aqueous polyselenide and polysulfide electrolytes respectively. Cell fabrication costs for these systems are compared with a test case comprising a sequence of processes in a typical fabrication of silicon p-n junction solar cells. A standardized methodology based on the solar array manufacturing industry costing standards improved price estimation guideline is employed for the comparison. Under the framework of assumptions implicit in this analysis, photoelectrochemical systems emerge as a viable cost-competitive option to silicon p-n junction solar cells. The sensitivity of the computed cell costs to parameters such as cell efficiency and material costs is discussed.

1824 **Residential photovoltaic systems costs.** Cox, C.H. III. (Massachusetts Inst. of Tech., Lexington). *Solar Cells;* **3**: No. 3, 245-262(May 1981).

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

A study of costs associated with the installation and operation of a residential photovoltaic system was conducted to determine present and projected (1986) status. As a basis for the study, a residential photovoltaic system design projected for 1986 was assumed, consisting of two principal components: a roof-mounted array and a utility-interactive inverter. The scope of the study encompassed both new and retrofit residential applications employing both silicon and CdS photovoltaic modules. Cost estimates were obtained by a survey and a study of reports generated by companies and agencies at present active in each of the subsystem areas. Where necessary, supplemental estimates were established as part of this study. The range of estimates for silicon-based systems strongly suggests that such systems will be competitive for new installations and reasonably competitive for retrofit applications. The CdS-based system cost estimates, which are less certain than those for silicon, indicate that these systems will be marginally competitive with silicon-based systems for new construction but not competitive for retrofit applications. Significant variations from the US Department of Energy system price subgoals were found, however, particularly in the areas of array mounting, wiring and cleaning. Additional development work appears to be needed in these areas.

1825 **Stability of photochemical mechanisms for photogalvanic cells.** Dung, M.H.; Kozak, J.J. (Univ. of Notre Dame, IN). *Journal of Photochemistry;* **14**: 205-232(1980).

A general analysis of the stability properties of photochemical mechanisms for photogalvanic cells is presented. A model, recently introduced, for photoredox systems is considered in which a one-electron redox couple (here an inorganic couple) reacts with a two-electron redox couple (here an inorganic couple) reacts with a two-electron redox couple (here an organic dye). The case of a well-stirred cell is considered first. A linear stability analysis and then a thermodynamic stability analysis are carried out for each of six possible mechanisms allowed by the model; similar analyses are performed to determine the stability at certain coordinates of the kinetic phase diagram where two (or more) mechanisms may compete. Taken together, the results of these analyses indicate that the photostationary state is asymptotically stable in all the kinetic regimes investigated. Next studied is how these conclusions are changed when diffusion of the reactants is taken into account explicitly. The general analysis is then specialized to treat a particular well-known photogalvanic cell, the iron-thionine system. The identity and the stability of the photostationary state for this system are investigated and are then quantified as functions of the concentration of the metal ion Fe^{3+} and the system illumination. Results on this specific photogalvanic system are examined in the light of known results on the stability properties of coupled chemical networks and are correlated with a recent study of the optimum efficiency of photogalvanic cells for solar energy conversion.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 1818

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 1834

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

REFER ALSO TO CITATION(S) 1834

1826 **(ANL/OTEC-BCM—022) Crevice corrosion and metal-ion concentration cell-corrosion resistance of candidate materials for OTEC heat exchangers, Parts I and II.** Kain, R.M. (Argonne National Lab., IL (USA); LaQue Center for Corrosion Technology, Inc., Wrightsville Beach, NC (USA)). May 1981. Contract W-31-109-ENG-38. 92p. NTIS, PC A05/MF A01. Order Number DE82000909.

Two separate studies are reported. In the first, titanium, stainless alloy AL-6X, Alclad 3003, aluminum alloy 5052, C70600, C72200 and Cu-10Ni-8Sn sheet materials were exposed to ambient temperature, low velocity seawater for 6 months and crevice corrosion and metal-ion concentration cell corrosion evaluations were conducted. Conditions were sufficiently critical to initiate crevice attack on control samples of Type 316 stainless steel. While no evidence of corrosion was detected for titanium and AL-6X, the five aluminum and copper base alloys all exhibited varying degrees of general and/or localized attack. In the second study, laboratory tests in low velocity, filtered seawater at 30°C resulted in initiation of crevice attack for 12 of the 13 stainless alloys included in the evaluation. For the most part, evidence of crevice corrosion initiation was detected within the first 30 days of exposure, although

considerable variation in the observed time to initiation of crevice corrosion was noted. (LEW)

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 1834

1827 **(NP—2900912) Passive-solar retrofit for the Acequia de San Jose de Abajo office in Sapello, New Mexico. Final technical report, February 1, 1980-August 31, 1981.** Cherng, J.C. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Nov 1981. 52p. (EMD—2-68-2223). New Mexico Energy and Minerals Department, P.O. Box 2770, Santa Fe, New Mexico 87501. Order Number DE82900912.

A retrofitted passive solar direct gain system for the Acequia de San Jose de Abajo (ASJA) office was designed, constructed, and completed. The existing building is a 768-square-foot adobe/rock structure. ASJA decided to remodel the building for office use as well as for a meeting place for the community. The solar system consists of two rows of south-facing vertical clerestory windows on the roof. This 150-square-foot area of clerestory windows was designed to provide a significant amount of heating (above 85 percent) to the building. The preliminary performance data have shown the building was able to maintain comfortable temperatures with very little backup. The backup system in the building is a fireplace. Because abundant wood is available in the adjacent forest, the fireplace is a cost-effective approach for the building. Site and building information, solar system design procedures, a computer mathematic model, and the preliminary performance evaluation are presented.

1828 **(NP—2900913) Design and instrumentation of a solar heating system to maintain adequate temperatures in emulsified asphalt storage tanks. Final report, February 18, 1980-June 30, 1981.** Koppenhaver, D.N.; Wilden, M.W. (New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). Nov 1981. 116p. (EMD—2-68-2129). New Mexico Energy and Minerals Department, P.O. Box 2770, Santa Fe, New Mexico 87501. Order Number DE82900913.

Applicable theory, physical properties, and steps necessary to design solar heated asphalt storage tanks for the New Mexico Highway Department are summarized. Specific designs are given for an above-ground 10,000 gallon system at Las Vegas, NM and a below-grade 12,000 gallon system at Socorro, NM. The design approach centers on developing a general modeling program into which various values, e.g., tank insulation properties, soil conductance, number of collectors, collector performance specifications, insolation and temperature data can be inserted and system performance can be predicted. The predicted performance values can be used to size the system and make economic comparisons. With appropriate changes, the program could be adapted to size a hot water heating system. Alternate instrumentation and data acquisition systems are proposed, along with suggestions for data reduction. The original scope of the project was to participate in the design, specification, and construction of the two sites and to conduct an analysis of the operating systems. However, due to delays the construction and operation phases have not been completed.

1829 **(P—500-81-018) Planning solar neighborhoods.** Hammond, J.; Zanetto, J.; Adams, C. (Living Systems, Winters, CA (USA)). Apr 1981. 180p. California Energy Resources Conservation and Development Commission, Sacramento. Order Number DE82900143.

Planning Solar Neighborhoods is a comprehensive manual for planning energy conserving residential developments in California. Due to the state's great climatic diversity, six climate regions are defined and key building, planning, and landscape planting guidelines are presented for each. A well illustrated chapter on solar building concepts includes a series of performance simulations of modifications to a standard house located in each of the state's climate regions. The heart of the manual describes solar and energy conservation options for neighborhood design including siting the development; relationships between street orientation, lot and building design; and the importance of flexible setback standards. Presentations on various types of high density housing and circulation planning techniques are given. The landscape planting chapter describes fundamental vegetation planning concepts, concentrating on species-specific tree selection and location techniques to maximize solar access and appropriate summer shading. The manual's most technical sections describe solar access planning fundamentals, design with shadows, working with difficult topography, and achieving solar access at high densities. Two summary chapters, Examples and Local Implementation, present an overview of whole neighborhoods designed for energy conservation, and the role of local governmen in promoting solar developments including subdivision review procedures.

1830 **(TAC-STC—81-003) Solar-thermal components: a bibliography with abstracts. Quarterly update, July-September 1981.** Bozman, W.R. (ed.). (New Mexico Univ., Albuquerque (USA). Technology Application Center). Sep 1981. 164p. Univ. of New Mexico, Albuquerque, NM 87131. Order Number DE82901081.

This annotated bibliography covers the following subjects: material properties, flat plate collectors, concentrating collectors, heat pumps, coolers and dehumidifiers, heat exchangers, solar ponds, distillation and desalination, and agricultural and industrial process heat. (MHR)

1831 **(TAC-STHC—81-003) Solar-thermal heating and cooling: a bibliography with abstracts. Quarterly update July-September 1981.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Oct 1981. 170p. University of New Mexico, Technology Application Center, Albuquerque, New Mexico 87131. Order Number DE82901062.

This annotated bibliography covers the following: demonstration programs; system overviews; computer calculations, designs, models, and simulations; thermal storage; architectural considerations; passive solar energy, air conditioning and cooling; service and domestic water heating; control systems; insolation, instruments, and monitoring systems; swimming pools; and greenhouses. (MHR)

1832 **Passive environmental temperature control system.** Corliss, J.M.; Stickford, G.H. (to Department of Energy). US Patent 4,280,333. 28 Jul 1981. Filed date 16 Mar 1979. vp.

Passive environmental heating and cooling systems are described, which utilize heat pipes to transmit heat to or from a thermal reservoir. In a solar heating system, a heat pipe is utilized to carry heat from a solar heat absorber plate that receives sunlight, through a thermal insulation barrier, to a heat storage wall, with the outer end of the pipe which is in contact with the solar absorber being lower than the inner end. The inclining of the heat pipe assures that the portion of working fluid, such as freon, which is in a liquid phase will fall by gravity to the outer end of the pipe, thereby assuring diode action that prevents the reverse transfer of heat from the reservoir to the outside on cool nights. In a cooling system, the outer end of the pipe which connects to a heat dissipator, is higher than the inner end that is coupled to a cold reservoir, to allow heat transfer only out of the reservoir to the heat dissipator, and not in the reverse direction.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 1821, 1830

1833 **(NP—2900670) Young solar collector: an evaluation of its multiple farm uses.** Heid, W.G. Jr. (Department of Agriculture, Washington, DC (USA)). May 1981. 19p. Department of Agriculture, Washington, DC 20250. Order Number DE82900670.

The homemade, low-cost Young flat-plate solar collector, well suited for multiple agricultural uses, was designed by a Nebraska farm couple and personnel from the Small Farm Energy Project. It is portable and tiltable, with a flexible airflow system. The collector satisfactorily dried grain and heated the Young farm home. Use of the collector in the fall and winter of 1979 saved 331

gallons of propane worth $179. Net energy savings yielded an 11.2-percent return on investment and, including allowable tax credits, gave a payback of 5.8 years, making this collector - with an expected 20-year life - an attractive investment for farmers and lending institutions.

1834 **Corrosion science and its application to solar thermal energy material problems.** Pohlman, S.L. (Solar Energy Research Institute, Golden, CO). pp 319-373 of Solar Materials Science. Murr, L.E. (ed.). New York, NY; Academic Press, Inc. (1980).

Several solar thermal technologies are reviewed, and anticipated material problems are discussed and ranked according to their currently perceived relative importance. The basic theories used in corrosion and electrochemical research are presented and their application to laboratory studies is shown. Weight loss, direct current, and digital alternating current methods of studying the kinetics of corrosion are described and an example of how weight loss data were employed to determine the corrosion kinetics of a thermal receiver is presented. 53 references. (LEW)

1420 Heat Storage

REFER ALSO TO CITATION(S) 1821, 1834

15 GEOTHERMAL ENERGY

1835 (INIS-mf—6285, pp 92-98) **Function of geothermal in Indonesia in future. 1.** Akil, I. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Function of geothermal energy in Indonesia in future including site selection, potention, development and utilization is described.

1836 (INIS-mf—6285, pp 99-113) **Prospects of the function of geothermal energy in Java/Bali. 2.** Akil, I. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Prospects of geothermal energy in Java and Bali covering energy exploration cost, production and consumption are described.

1837 **First SINO/US geothermal resources conference.** Klamath Falls, OR; Oregon Institute of Technology (1981). 270p. (CONF-810471—).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

Twenty-three papers are included. A separate abstract was prepared for each paper. (MHR)

1501 Resource Status And Assessment

1838 **Geothermal utilization and development in the United States.** Berge, C.W. (Phillips Petroleum Co., Salt Lake City, UT); Lund, J.W. pp 15p, Paper 4 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The United States utilizes geothermal energy for electrical power generation and for a variety of direct-use applications. The most notable developments are at The Geysers in northern California where approximately 900 MWe are being generated and at Klamath Falls, Oregon, and Boise, Idaho, where major district heating projects are under construction. Geothermal development is promoted and undertaken by private companies, public utilities, the federal government (the Department of Energy and the Geological Survey) and by state and local governments. The best estimates for development by the year 2000 include over 10,000 MWe of electrical power generation and over 0.5 quads/year (0.5×10^{15} kJ/year) of direct heat use.

1839 **Nature and occurrence of geothermal resources in the United States.** Wright, P.M. (Univ. of Utah, Salt Lake City). pp 22p, Paper 21 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981). Contract AC07-80ID12079.

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

An overview is presented of the geology of geothermal resources. Emphasis is on resources in the United States, but the geological principles discussed have world-wide application. It is shown that geothermal resources of high temperature are found mainly in areas where a number of specific geologic processes are active today and that resources of lower temperature are more widespread. A classification is presented for observed resource types and the geology of each type is described briefly. The geology of the United States is summarized to provide an appropriate background for consideration of the occurrence of geothermal resources. Finally the conclusion is reached that the accessible geothermal resource base in the United States is very large and that the extent of development over the next decades will be limited by economics rather than by availability.

1502 Geology And Hydrology Of Geothermal Systems

1840 **Geothermal resource exploration geology.** Ciancanelli, E.V.; Johnson, K.E. (Cascadia Exploration Corp., Escondido, CA). pp 8p, Paper 6 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

Geologic exploration for geothermal energy is directed mainly toward locating high temperature reservoirs. The classic reservoir model consists of a young igneous intrusive heat source surrounded by hot wall rocks. Fractures and pore spaces filled with ground water and lying within the heated wall rock comprise the geothermal reservoir. Ascending high temperature water produces hydrothermal alteration and surface thermal manifestations of the reservoir. Geothermal geology utilizes library research, geologic mapping, photogeology, water and trace element geochemistry, petrography, geochronology, and geophysics to explore the geothermal potential of an area. Discovery followed by utilization result from the successful application of these techniques.

1503 Geothermal Exploration And Exploration Technology

1841 **Exploration case history of Roosevelt Hot Springs, Utah, USA.** Berge, C.W. (Phillips Petroleum Co., Salt Lake City, UT). pp 5p, Paper 2 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The investigations of the Roosevelt geothermal field include hydrochemistry, chemical geothermometry, petrography, gravity, magnetics, resistivity (dipole mapping and MT), groundnoise and thermal gradient drilling. A model assimilating the data was formulated. Additional resistivity, thermal gradient drilling and deep drilling has resulted in modifications of the earlier model. The thermal anomaly is underlain by intermediate and silicic crystalline rocks, at the surface or at shallow depths. The reservoir is a fracture system. The depth to its top is less than 900 meters over a significant portion of the anomaly. The fracture zones have extraordinarily high effective permeability yielding up to 113,000 kg/hr flashed steam from a reservoir with temperatures in excess of 250°C, with pressures near hydrostatic, and with fluids of less than 8000 ppM total dissolved solids.

1842 **Exploration case history of Desert Peak, Nevada, USA.** Berge, C.W.; Benoit, W.R. (Phillips Petroleum Co., Salt Lake City, UT). pp 3p, Paper 3 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The Desert Peak Geothermal field was discovered by temperature-gradient hole drilling. Temperature-gradient holes up to 152 meters (500 feet) deep have defined a near-surface thermal anomaly covering in excess of 260 square kilometers (100 square miles). Deeper temperature-gradient holes and production holes have shown that thermal water from the reservoir is leaking into at least three near-surface aquifers. These aquifers can extend for several miles beyond the reservoir boundary and therefore make it difficult to outline the reservoir. To date electrical methods have not been helpful in locating reservoir boundaries. The reservoir is in fractured Mesozoic greenstones and has a maximum measured temperature of 208°C (406°F). The reservoir water is a sodium-chloride water which is three times more saline than the thermal water in the nearby Brady Hot Springs system. The youngest recognized siliceous volcanic unit in the area is 11.2 m.y. old. Therefore, the heat source in this area is probably not magmatic.

1843 **Geophysical exploration for geothermal resources: strategy and techniques.** Combs, J. (Geothermal Services, Inc., San Diego, CA). pp 12p, Paper 7 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The following are discussed: exploration strategy, fundamental concepts, background considerations, structural methods, electrical and electromagnetic methods, drilling, geophysical logging, and exploration costs. (MHR)

1844 **Exploration, the techniques and strategies.** Greider, B. (Geothermal Resources International, Inc., Menlo Park, CA). pp 16p, Paper 10 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The exploration for a geothermal reservoir is capital-intensive, requires planning and long times until positive income is achieved. A geothermal field development to the point of utilization requires extensive engineering, planning, and significant capital. The objectives are to locate, analyze, and acquire the areas that can produce economic and useful quantities of geothermal energy. Evaluation of the risks of finding adequate producible and useable energy with the available techniques and funds provides analysis of the exploration plans. Exploration wells now cost about $200 per foot drilled. Development of a 50MW field and plant requires more than 76 million dollars. A development must provide more than 25% rate of return on the investment to compete with low risk investments.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 2487

1845 **(P—700-81-012) Occidental Geothermal, Inc., Oxy Geothermal Power Plant No. 1: draft environmental impact report.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Aug 1981. 375p. California Energy Resources Conservation and Development Commission, Sacramento 95825. Order Number DE82900600.

The following aspects of the proposed geothermal power plant are discussed: the project description; the environment in the vicinity of project as it exists before the project begins, from both a local and regional perspective; the adverse consequences of the project, any significant environmental effects which cannot be avoided, and any mitigation measures to minimize significant effects; the potential feasible alternatives to the proposed project; the significant unavoidable, irreversible, and long-term environmental impacts; and the growth inducing impacts. (MHR)

1846 **Environmental effects of geothermal development.** Swanberg, C.A. (New Mexico State Univ., Las Cruces). pp 11p, Paper 20 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The sources of geothermal related pollution are outlined and the abatement programs which have proven most successful in minimizing the impact to the environment are summarized. Monitoring is stressed for all phases of geothermal activity including predevelopment monitoring. Air, water, thermal, and noise pollution, land subsidence, seismic effects, and land use are discussed. (MHR)

1508 Geothermal Power Plants

1847 (INIS-mf—6285, pp 122-137) **Prospects of the function of geothermal energy in the nasional energy program.** Radja, V.T. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Prospects of geothermal energy on national energy program in Indonesia, including the disturbances, planning, cost and exploration are presented.

1848 **Status of the use of geothermal energy for power generation in the United States of America.** Kuwada, J.T. (Geothermal Kinetics, Inc., San Francisco, CA). pp 11p, Paper 12 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The use of geothermal energy for commercial electric power generation in the United States began in 1960 at The Geysers. The liquid dominated resources discovered in the US, on the other hand, posed many more technical and economic uncertainties which have hindered development. It was only last summer that the US first witnessed its geothermal power plants in operation utilizing liquid dominated resources. One plant is an 11 MWe binary fluid cycle power plant operating on a moderate temperature (350°F) geothermal brine which is pumped from the wells to the power plant. The other power plant is a 10 MWe single flash steam power plant operating on steam derived from a high temperature, high salinity brine which is produced from the wells by flashing flow. Both plants are located in the Imperial Valley of California; they illustrate the diversity in resource characteristics that can be encountered in liquid dominated geothermal resources, which compound the problems of their use.

1849 **50-MW Baca geothermal power plant project.** Leung, P.; Bouma, J. (Bechtel Power Corp., Norwalk, CA). pp 25p, Paper 13 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The geothermal resource development to date is described as follows: site and geothermal sources studies, environmental studies, geology, and drilling and production. The power generating plant is described including: the turbine cycle selection, the turbine-generator system, and the H_2S abatement system. Special design features for the Baca Power Plant include: a clean room, the use of fiberglass reinforced piping and tanks, and the turbine generator and geothermal steam field response. (MHR)

1509 Geothermal Engineering

1850 **Prevalent geothermal drilling practices.** Capuano, L.E. Jr. pp 22p, Paper 5 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

A comprehensive and in depth study of geothermal well drilling must include a review of the current state of the art technology for drilling operations in all types of reservoir conditions. The material presented discusses the major topics of predrilling considerations, the detailed drilling program, drilling fluids, cements, wellhead assemblies, blowout preventer configurations, and

certain special considerations that have become prevalent in geothermal well drilling. The vapor dominated resource and the liquid dominated resource are treated individually to clearly delineate the respective drilling operations and support functions.

1851 **Current US corrosion engineering technology and its relevance to geothermal heating systems of the People's Republic of China.** Ellis, P.F. (Radian Corp., Austin, TX). pp 10p, Paper 8 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The economic utilization of geothermal resources with temperatures up to 105°C requires creation of systems with long plant life and minimum operation and maintenance costs. Based on a study of 20 low temperature direct (non-electric) utilization systems in the United States and abroad, general corrosion engineering guidelines are presented. Piping, valves, and heat exchange equipment are considered. These guidelines are applicable to a large number of resources, including many resources in the People's Republic of China.

1852 **Geothermal reservoir engineering.** Zais, E.J. (Elliot Zais & Associates, Inc., Corvallis, OR). pp 4p, Paper 22 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

Geothermal reservoir engineering has many similarities to and differences from petroleum reservoir engineering. Reservoir engineering consists of three broad categories: (1) reservoir and resource assessment by geo-methods; (2) well and reservoir transient testing; (3) field management and long term testing and modeling.

1853 **Production decline analysis.** Zais, E.J. (Elliot Zais and Associates, Inc.); Bodvarsson, G. pp 3p, Paper 23 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

Data from Wairakei, The Geysers, Larderello and Cerro Prieto were analyzed using traditional production decline methods borrowed from the petroleum industry. Arps's exponential equation works quite well in many cases. His hyperbolic equation works very poorly and should be avoided. Several types curves were tried with little success. Coats and Bodvarsson each developed easy to use methods for predicting either pressure or production given the other and historical data. Coats's influence function model requires only production and pressure data from which an influence function step or impulse response can be calculated. No reservoir model need be assumed. Bodvarsson's linearized free surface assumes that a free liquid surface is present and that enough data are available to define a sinking velocity. The sinking velocity equals permeability times gravity divided by porosity times kinematic viscosity. Both methods worked well on the data tested.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 1851

1854 **Planning and development of geothermal direct utilization in Klamath Falls, Oregon.** Allen, E.M. (Eliot Allen & Associates, Inc., Salem, OR). pp 10p, Paper 1 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The direct utilization of geothermal energy in Klamath Falls, Oregon is described in terms of its planned development for multiple purposes within an urban infrastructure. Klamath Falls is the site of the United States' largest direct use of geothermal energy, presently estimated at over 2000 x 10^9 kJ/year at over 500 sites in the city. These direct uses are predominantly space heating, but also include industrial process, aquaculture, and highway de-icing applications. The general geological and hydrological conditions in Klamath Falls are described, as is the one-hundred year history of direct geothermal utilization in the community. The preparation and implementation of a municipal geothermal development plan in the 1970's is reviewed, including the following plan elements: municipal planning, geothermal resource exploration and production, and district heating system design.

1855 **Use of geothermal energy for aquaculture.** Johnson, W.C. (Oregon Inst. of Tech., Klamath Falls, OR). pp 4p, Paper 11 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

Aquaculture at Oregon Institute of Technology (OIT) has used a crustacean, the giant freshwater prawn, Machrobrachium rosenbergii, culturing it in the waste geothermal discharge of the college. This work has provided data demonstrating that a tropical crustacean can be grown in a cold climate where the water temperature is maintained at the optimal growing temperature for this species, 27°C to 30°C. This crustacean is considered a food delicacy and demands a high market price. Before the prawns were introduced, some short-term work was done with finfish to determine the suitability of the geothermal water. The most recent work is the trout culture now in progress. A plumbing system for the OIT aquaculture ponds was developed to provide an even distribution of the geothermal energy throughout the ponds. It consists of perforated diffuse pipes, control valves, and thermostats which are used to maintain an optimal temperature in the ponds. All plumbing materials used are standard items manufactured by the plumbing industry.

1856 **Geothermal district heating analysis guide.** Lienau, P.J. (Oregon Inst. of Tech., Klamath Falls). pp 18p, Paper 14 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

This analysis guide is designed to aid developers in the preliminary evaluation of the feasibility of district heating using heat produced from geothermal fields. System feasibility is accomplished by proceeding through five analysis steps: (1) estimating geothermal heat production; (2) procedures for identifying district heating market areas and estimating their peak heating loads and annual energy use; (3) preliminary design considerations for district heating system; (4) analysis of economic aspects of district heating systems; and (5) evaluation of district heating feasibility. The analysis is applied to the city of Klamath Falls, Oregon, which is building a geothermal district heating system for the Commercial Business District.

1857 **Sample geothermal district heating project design of the Klamath Falls geothermal district heating network.** Lienau, P.J. (Oregon Inst. of Tech., Klamath Falls). pp 6p, Paper 15 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The City of Klamath Falls is constructing a geothermal district heating network for the central business district. Initially, the system will heat 14 government buildings (Phase 1 - 4.4 MW/sub t/) in the downtown area, subsequently expanded to heat 11 blocks (Phase II - 8.5 MW/sub t/) and then to heat the entire 54-block central business district (Phase III - 40 MW/sub t/). Two production wells have been drilled along the east boundary of the city, each tested at over 700 gpm of 220°F water or 10.3 MW/sub t/ which is ample capacity for Phase I of the project. A primary 10-inch diameter insulated steel pipeline placed in a concrete duct will supply geothermal fluid to a central heat exchange facility 4060 feet from the production wells. Two plate heat exchangers will provide the necessary load for the initial 14 buildings. An injection well is located adjacent to this facility. A closed secondary pipeline will supply heat to the 14 buildings at 200°F. This line will consist of buried insulated fiberglass reinforced plastic pipe. The capital cost of the system (Phase I) will be $1.4 million giving an equivalent annual capital, operation and maintenance cost over a 20-year

period of $216,096. Phase II cost of geothermal energy is estimated at $5.83 per million Btu, whereas, the equivalent annual fossil fuel cost is estimated at $8.20 per million Btu.

1858 **Industrial applications of geothermal energy.** Lund, J.W. (Oregon Inst. of Tech., Klamath Falls, OR). pp 21p, Paper 16 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

Industrial uses of geothermal energy include process steam, direct heat and electricity generation. Present worldwide applications range from fish, grain, mineral and timber drying, to pulp and paper processing, and to chemical recovery. In industrial applications, geothermal fluid temperatures up to 150°C are considered for basic processes such as preheating, washing, cooking, evaporation, sterilizing, distilling, drying and refrigeration. Three processes are described in detail: vegetable dehydration, milk pasteurization and grain drying. Onion dehydration using geothermal hot water can be accomplished by a continuous conveyor dryer using around 100°C temperature hot air. A typical processing plant will handle 4500 kg of raw product per hour (single line) to produce approximately 750 kg of finished product at 40 x 10^3 kJ per kg of dry product. Milk pasteurization requires 77°C temperature for a minimum of 15 seconds. A plate heat exchanger is used in the pasteurization process. Alfalfa dehydration uses a forced-air system. A multi-layer conveyor belt process can produce pellets using 135°C, whereas a field wilting and rotary drum dryer can use temperatures as low as 80°C. Additional factors to consider in process-heating applications are retrofit, heat pumps and the need for heat exchangers.

1859 **Equipment used in direct heat projects.** Ryan, G.P. (Oregon Inst. of Tech., Klamath Falls). pp 14p, Paper 17 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

Geothermal well pumps are normally either the submersible type or the turbine type. Submersibles are necessary if the lift is high, say 240 m (800 ft) or more. If a turbine pump can be used, a variable speed driver should be considered. These drivers permit no load starting, reduce shock and vibration, and minimize horsepower requirements. In the range of flow between 20% and 60% of design, the power savings is about 40% when compared to regulating flow by throttling. Plate heat exchangers are less expensive and more effective than tube heat exchangers in the usual geothermal applications. They can be used as the key component in a two loop system to minimize the effect of corrosion and deposits.

1860 **Agriculture, greenhouse, wetland and other beneficial uses of geothermal fluids and heat.** Schmitt, R.C. (EG & G Idaho, Inc., Idaho Falls). pp 12p, Paper 18 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

Beneficial uses of fluid and heat from geothermal resources have been evaluated in experiments and implementation in the United States in sufficient numbers to provide a base of data that can be of value to the development of such geothermal utilization in the People's Republic of China. This paper presents the status for related beneficial uses including agriculture, greenhousing, and geothermal wetlands. Information on heat dissipation, animal husbandry and other uses is presented. Data published for the geothermal fluids found in areas of China have been examined and compared with the geothermal fluids used in the agriculture evaluations in the United States. This comparison indicates that the geothermal fluids found in parts of China are similar to those used in the US agriculture experiments, making the US results applicable.

1861 **Industrial processing using thermal energy from geothermal resources.** Schultz, R.J.; Hanny, J.A. (Engineering and Economics Research, Inc., Idaho Falls, ID). pp 6p, Paper 19 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The key engineering and economic factors that must be considered prior to and during development of a geothermal resource and for industrial processing applications are presented in a notated outline form. Three key process areas are described emphasizing the changes that are required to incorporate geothermal energy utilization into the process. The processes that are discussed are motor fuel grade alcohol production, fluidized bed drying and cooling/refrigeration.

1520 Geothermal Data And Theory

1862 **Geochemistry applied to geothermal resources exploration and production.** Fournier, R.O. (US Geological Survey, Menlo Park, CA). pp 10p, Paper 9 of First SINO/US geothermal resources conference. Klamath Falls, OR; Oregon Institute of Technology (1981).

From 1. Sino/U.S. geothermal resources conference; Tianjin, China (5 Apr 1981).

The role of geochemistry in determining the source and age of water, studying hydrothermal reactions, estimation of reservoir temperature, and modeling underground mixing of hot and cold waters is discussed. Sampling strategy and interpretative procedures are described. (MHR)

17 WIND ENERGY

1701 Availability (climatology)

1863 **(NP—2900401) Wind energy: investing in our energy future.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Apr 1981. 29p. California Energy Resources Conservation and Development Commission, 1111 Howe Avenue, Sacramento, CA 95825. Order Number DE82900401.

The California Energy Commission's Wind Program was initiated in 1977 and later expanded by the passage in 1978 of California Assembly Bill 2976 authored by Assemblyman Henry Mello. The Mello Bill requires the Energy Commission to implement a state wind energy program that expedites the commercialization of utility-scale wind turbines. Specific Energy Commission responsibilities under the Mello Bill include: assessment of wind resources throughout California; operation of a public wind information center; testing of wind-electric turbines; and research leading to the development of large-scale prototype wind turbines to meet California's electricity needs. The goal of the Commission's Wind Program is to produce ten percent of the state's electricity from wind energy by the year 2000. This would currently correspond to about 7700 megawatts of installed capacity and would result in a direct savings of 40 million barrels of oil each year.

1864 **(P—500-80-052) Wind-resource potential in California.** Miller, A.; Simon, R.L. (San Jose State Univ., CA (USA). Dept. of Meteorology). Sep 1980. 92p. California Energy Commission, Sacramento. Order Number DE82900602.

Maps were developed for California delineating areas of good and excellent wind resource potential (11-14 mph and greater than 14 mph mean annual wind speed, respectively). After examining nearly 700 station records of wind measurements, 407 sites were selected as representative of good exposure, nonredundancy, and reliability of data. Knowledge of diurnal, seasonal, and altitudinal variations in the wind, prevailing atmospheric circulation, and interaction of wind with terrain were used to (1) adjust the computed mean annual wind speed of the 407 stations so as to make them representative of the expected true annual means, and (2) estimate wind speeds in regions of sparse wind data. Data summaries have been compiled for the 407 stations used to generate the California wind resource maps and for 60 promising sites with unsummarized data records.

1704 Economics

REFER ALSO TO CITATION(S) 1863

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 1863, 1864

1865 **(P—500-80-060) Wind energy demonstration project in cooperation with the US Fish and Wildlife Service: revised negative declaration and initial study.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Nov 1980. 30p. California Energy Resources Conservation and Development Commission, 1111 Howe Avenue, Sacramento, CA 95825. Order Number DE82900349.

The project is a joint venture with the US Fish and Wildlife Service (FWS). The FWS would use the electricity in its Headquarters and Interpretive Center building and related facilities. Pacific Gas and Electric (PG and E) has agreed to buy any excess power produced. Upon completion of installation, the FWS will be responsible for operation, maintenance, and repair of the system. The California Energy Commission (CEC) will provide: funds for the purchase, delivery, and installation of a 25 kilowatt (kW) wind turbine; consultation for the wind display, graphics, and informational literature; supervision and coordination of the project between the FWS, PG and E, the manufacturer, and the CEC.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

1866 **(CW-WR—76-015.47A) Engineer, design, construct, test and evaluate a pressurized fluidized-bed pilot plant using high-sulfur coal for production of electric power: Phase I, preliminary engineering, Phase II, final design. Annual report, March 1, 1978-February 28, 1979.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). 1979. Contract AC21-76ET10417. 110p. (FE—1726-47A). NTIS, PC A06/MF A01. Order Number DE82000494.

During this period the steam-gas turbine/pressurized fluidized bed (SGT/PFB) Technology Unit was operated for an additional 800 h on high sulfur coal during which the complete range of pilot plant operating parameters was covered. Data on bed-side heat transfer, bed operation, heat exchanger materials characteristics and hot gas cleanup performance were obtained. Following the initial shakedown period the PFB combustor performed at near design conditions for the 800 h of testing. The cumulative coal operating time on the rig is 894 h. Coal combustion was initiated at bed temperatures of 850 to 900°F although startup at 1100 to 1200°F was the normal procedure. Start-up with a full height deep bed was demonstrated which precluded the need for bed material removal prior to start-up as other investigators have found. Temperature distribution over the full bed height during design point and off-design operation was uniform and there was no indication of freeboard combustion. SO_2 aour at x approximately 0 up to 250 GeV/c.

1867 **Computer aided optimal design of compressed air energy storage systems.** Ahrens, F.W. (Argonne National Laboratory, Argonne, Ill.); Sharma, A. (Illinois, University, Chicago, Ill.); Ragsdell, K.M. (Purdue University, West Lafayette, Ind.). *Journal of Mechanical Design;* **102**: 437-445(Jul 1980).

An automated procedure for the design of Compressed Air Energy Storage (CAES) systems is presented. The procedure relies upon modern nonlinear programming algorithms, decomposition theory, and numerical models of the various system components. Two modern optimization methods are employed BIAS, a Method of Multipliers code and OPT, a Generalized Reduced Gradient code. The procedure is demonstrated by the design of a CAES facility employing the Media, Illinois Galesville aquifer as the reservoir. The methods employed produced significant reduction in capital and operating cost, and in number of aquifer wells required.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 1723, 2312, 2446

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 2076

21 NUCLEAR POWER PLANTS

1868 (INIS-mf—6285, pp 114-121) **Prospect of Nuclear Power Plants.** Budi, S. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Prospects of nuclear power plant, including probability of energy consumption and economics are presented.

1869 **Nuclear energy - 25 years of generating experience.** Tombs, F. (Electricity Council, London (UK)). pp 33-39 of Energy Australia 1979. Papers presented on the occasion of the Diamond Jubilee Conference of the Institution of Engineers, Australia, held in Perth, 31st March to 6th April, 1979. Endersbee, L.A. (ed.). Perth, Australia; Institution of Engineers, Australia (1979).

From Diamond jubilee conference of the institution of engineers; Perth, Australia (31 Mar 1979).

The development of nuclear power, with particular reference to the United Kingdom, is outlined. Advantages and disadvantages of different reactor types in terms of efficiency, safety, maintenance and cost are discussed. Other areas considered include the development of techniques for the maintenance and repair of gas-cooled reactors and the history of fast reactor development in Britain.

1870 **Electricity supply - matters of current concern.** Booth, E.S. (Yorkshire Electricity Board. (UK)). pp 67-83 of Energy Australia 1979. Papers presented on the occasion of the Diamond Jubilee Conference of the Institution of Engineers, Australia, held in Perth, 31st March to 6th April, 1979. Endersbee, L.A. (ed.). Perth, Australia; Institution of Engineers, Australia (1979).

From Diamond jubilee conference of the institution of engineers; Perth, Australia (31 Mar 1979).

Some aspects of public electricity supply in Britain are reviewed. Topics covered include a brief introduction on the organisation of the Electricity Supply Industry in England and Wales, the history of the nuclear power industry from the first Magnox stations to the second generation of nuclear reactors, the advanced gas-cooled reactors, and the prospects for building a commercial fast reactor. Consideration is given to renewable energy sources and to the possibility of using spare nuclear capacity at night for the electolytic production of hydrogen from water. Some environmental aspects such as the problem of power station emissions are touched on, and the prospects for using reject heat from power stations for district heating are considered, although at present these seem uneconomic.

1871 **Solar not nuclear. An assessment of possible future trends in energy production in Australia.** Kemeny, L. (New South Wales Univ., Kensington (Australia). School of Nuclear Engineering). pp 50-63 of Energy Australia 1979. Papers presented on the occasion of the Diamond Jubilee Conference of the Institution of Engineers, Australia, held in Perth, 31st March to 6th April, 1979. Endersbee, L.A. (ed.). Perth, Australia; Institution of Engineers, Australia (1979).

From Diamond jubilee conference of the institution of engineers; Perth, Australia (31 Mar 1979).

Two possible options open to society over the next few decades are technologically developed nuclear fission energy or the perceptually attractive, but economically and technically daunting , techniques of solar energy. It is apparent that the formulation of an Australian energy policy based on a combination of fossil and non-

fossil fuels, and incorporating the utilisation of alternative technologies and renewable energy sources such as solar energy, must be subject to the dual constraints of technical feasibility and economic realism. In this paper the costing of locally generated solar energy for various domestic and industrial uses is reveiwed and summarised. A comparison is made with the tariffs charged for energy from centrally located Australian power plants. The environmental and societal impact of the two technologies is briefly discussed and overseas costing projections and solar plant concepts are cited. Whilst it may be two decades before an Australian nuclear industry is established and the first nuclear power plant is commissioned, tentative projections are made of relative costs of solar and nuclear technologies based on recent overseas developments.

1872 **Energy Australia 1979. Papers presented on the occasion of the Diamond Jubilee Conference of the Institution of Engineers, Australia, held in Perth, 31st March to 6th April, 1979.** Endersbee, L.A. (ed.). Perth, Australia; Institution of Engineers (1979). vp. (CONF-7903152—). NTIS (US Sales Only).

From Diamond jubilee conference of the institution of engineers; Perth, Australia (31 Mar 1979).

Separate abstracts are presented for each of the conference papers included in the data base.

1873 **Approach to reliability in nuclear power plants.** Bicevskis, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). pp 8-22 of Availability and reliability symposium. Held in Sydney, Australia, 24-25 October 1978. Sydney, Australia; Institution of Engineers, Australia (1978).

From Availability and reliability symposium; Sydney, Australia (24 Oct 1978).

The basic concepts of reliability and availability are discussed in the context of the historical development of nuclear power plants. The measures that can be taken at the design and operating stages are reviewed. The need for representative failure data is stressed and current efforts in data collection are described. Useful data collections already exist in the electronic field and a considerable amount of analytical work has been done, in particular, on reactor protection systems.

1874 **Availability and reliability symposium. Held in Sydney, Australia, 24-25 October 1978.** Sydney, Australia; Institution of Engineers (1978). vp. (CONF-7810262—). NTIS (US Sales Only).

From Availability and reliability symposium; Sydney, Australia (24 Oct 1978).

Separate abstracts are presented for each of the conference papers included in the data base.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 2056

1875 (IWGFPT—8, pp 18-30) **Fuel performance under power ramp conditions in the HBWR.** Vilpponen, K.O.; Foerdestroemmen, N.; Svanholm, K.; Minagawa, Y. (Institutt for Energiteknikk, Halden (Norway). OECD Halden Reaktor Prosjekt). Jan 1981. Dep. NTIS (US Sales Only).

From Specialists' meeting on pellet-cladding interaction in water reactors; Roskilde, Denmark (22 Sep 1980).

The aims of the overpower ramp testing programme at the OECD Halden Reactor Project are to obtain a better understanding of the phenomena contributing to fuel rod defection during power ramps and to identify design changes and operational procedures for avoiding such defects. In-pile measurements together with a comprehensive post irradiation programme have provided a consistent data base on pellet-cladding interaction induced defects. This paper represents a summary of the ramp tests conducted at HBWR, including close to sixty rods. The data cover a range of gap sizes (60 - 300 μm), densities (90 - 97% TD), ramp rates (.04 - 36 W/cm/min) and special design features (vipac, lubricants, centre hole) together with a variety of power histories up to 25 MWd/kg UO_2 burn-up. Defects were consistently associated with ridges, the severity being related to ridge strain. Typically, failed rods exhibited ridge strains exceeding 0.1% and in-pile axial stress levels exceeding 100 MPa.

1876 **Residual stress improvement for pipe weld by means of induction heating pre-flawed pipe.** Umemoto, T.; Yoshida, K.; Okamoto, A. pp 131-137 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The intergranular stress corrosion cracking (IGSCC) has been found in type 304 stainless steel piping of several BWR plants. It is already well known that IGSCC is most likely to occur when three essential factors, material sensitization, high tensile stress and corrosive environment, are present. If the welding residual stress is sufficiently high (200 to approximately 400 MPa) in the inside piping surface near the welded joint, then it may be one of the biggest contributors to IGSCC. If the residual stress is reduced or reversed by some way, the IGSCC will be effectively mitigated. In this paper a method to improve the residual stress named IHSI (Induction Heating Stress Improvement) is explained. IHSI aims to improve the condition of residual stress in the inside pipe surface using the thermal stress induced by the temperature difference in pipe wall, that is produced when the pipe is heated from the outside surface by an induction heating coil and cooled on the inside surface by water simultaneously. This method becomes more attractive when it can be successfully applied to in-service piping which might have some pre-flaw. In order to verify the validity of IHSI for such piping, some experiments and calculations using finite element method were conducted. These results are mainly discussed in this paper from the view-points of residual stress, flaw behaviour during IHSI and material deterioration.

1877 **Use of the intermediate test vessel for analysing nozzle corner cracks. A photoelastic analysis.** Smith, C.W.; Peters, W.H. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). pp 155-161 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

A description is given of the Intermediate Test Vessel (ITV) devised at ORNL as a test model for investigating surface flaws and corner cracks in inlet and outlet nozzles by reducing the size of the vessel while maintaining both wall thickness and nozzle geometry at full size. Recent studies on photoelastic models of boiling water reactors (BWRs) have revealed that flaw shapes at the nozzle corner are not simple and that flaw growth is not self similar. Consequently, the stress intensity factor (SIF) distributions are different from those obtained by numerical analysts by assuming simple flaw shapes and self similar flaw growth. Following a brief description of the experimental method for Mode I SIF determination, results obtained from tests on photoelastic models of both ITVs and BWRs will be compared and an assessment of the ITV test as a proof test for a BWR will be made. Moreover, comparisons of the photoelastic results with the open literature will be included even though certain differences as noted above are involved.

1878 **Natural shaped flaws at nozzle corners with pressure loading and thermal shock.** Kathiresan, K.; Atluri, S.N. (Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering). pp 163-168 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Solutions of stress intensity factors along the borders of pressurized corner cracks at the juncture of nozzle and pressure vessel, which are computed by the use of a three dimensional hybrid displacement finite element procedure, are presented. Also included

are the solutions of stress intensity factors along the crack front for inner semi circular and semi elliptical surface flaws subjected to thermal shock loadings. The finite element method used is based on the stationary condition of a modified total potential energy principle in which the arbitrary element interior displacements, interelement boundary displacements and element boundary tractions are the three field variables. The proper asymptotic square root and inverse square root variations in displacements and stresses, respectively are embedded in this procedure of developing special crack front elements where the three modes of fracture corresponding to Ksub(I), Ksub(II) and Ksub(III) are taken into account. The procedure yields the global nodal displacements and the stress intensity factors along the crack front as solutions. Natural shaped flaws, as observed in experiments are modeled in the present analyses for BWR and ITV configurations. For thermal shock problems, geometries of commercial nuclear pressure vessels, with outer to inner diameter ratio of 10/9, crack aspect ratios of a/c = 0.2 and 1.0, and crackdepths of 40 per cent and 60 per cent of the cylindrical wall thickness, are considered.

1879 **Application of narrow-gap GMA welding process to nuclear reactor pressure vessels.** Sawada, S.; Ohta, M.; Nishioka, A.; Hori, K.; Kawahara, M.; Yamasaki, H. (Babcock Hitachi K.K., Tokyo (Japan)). pp 113-118 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Babcock-Hitachi K.K. has applied a newly developed narrow-gap GMA welding process to the fabrication of pressure vessels which require high quality welds since July 1976. On the basis of the results of tests performed during the period, we have decided to apply this narrow-gap GMA welding process to the welding of longitudinal, circumferential, and nozzle-to-shell joints on a 1100 MW boiling water type nuclear reactor pressure vessel. The following points have been revealed from the results of tests carried out on actual products and of relating investigations. Basic strength characteristics among the mechanical properties of the narrow-gap GMA welded joints have proved to satisfy the value of base metal specified in JIS and the ASME CODES. RTsub(NDT) in the fracture toughness of the weld showed -39°C to -59°C in the base metal, -75°C in the HAZ, and -70°C in the weld metal. These values are lower by -10°C to -15°C compared with those of SAW and SMAW welds. The tests have also revealed that the dynamic fracture toughness distributions in the weld metal and HAZ are higher than that of the base metal. The temperature dependence characteristics are on the safer side of the base metal data band. As for characteristics of crack initiation by fatigue, it has been found that there is more margin than the design curve shown in the ASME CODE SEC.III. With respect to propagation, it has been confirmed that the propagation rate is equal to or less than that of the base metal.

1880 **Reactor pressure vessel design using large forgings for easier ISI.** Suzuki, K.; Nishiya, M. (Japan Steel Works Ltd., Muroran, Hokkaido. Muroran Plant); Ishikawa, K. (Ishikawajima-Harima Heavy Industries Co. Ltd., Yokohama (Japan)). pp 71-75 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

To meet inservice inspection requirements for nuclear reactor vessels, design of the bottom head of a BWR reactor pressure vessel has to be modified to have better accessibility for inspection equipment. New techniques for large forged heads have been developed which minimize the number of weld seams in the bottom head. Test results of material properties show the superior characteristics in comparison with steel plate heads.

1881 **Hybrid model for studying the feedwater control system of a BWR power plant.** Biserna, T.G.; Guardincerri, A.; Piatesi, M. pp 1049-1054 of Simulation of systems '79. Proceedings of the 9th IMACS congress held at Sorrento, Italy, 24-28 September 1979. Dekker, L.; Savastano, G.; Vansteenkiste, G.C. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From IMACS congress 1979: simulation of systems; Sorrento, Italy (24 Sep 1979).

This report describes briefly the mathematical model of a BWR power plant feedwater system and its implementation on a hybrid computer. The structure of some blocks of the model and the values of some of its coefficients were determined according to the analysis of experimental transients recorded during tests carried out on the plant before its start-up.

1882 **Forgings for pressurised components of a nuclear steam supply. Chapter 2.** Ando, Y. (Tokyo Univ. (Japan)). pp 35-59 of Developments in pressure vessel technology - 3. Materials and fabrication. Nichols, R.W. (ed.). London, England; Applied Science (1980).

The application of forgings for nuclear reactor pressure vessels and other components of a nuclear steam supply system has increased in recent years. Chemical composition and properties of typical forgings to secure the required mechanical properties, weldability, toughness and resistance to neutron irradiation effects are discussed. Examples of manufacturing processes and quality control to ensure high-quality steel are presented. It is found to be important to control chemical composition, to eliminate impurities such as P, S and Cu and to keep hydrogen gas below specified low levels. Strict control of temperature in hot working and in heat treatment is essential. Various examples of forgings, such as flange, shell, combined vessel flange and nozzle belt, bottom head and miscellaneous applications are shown.

1883 **Fabrication aspects of large pressure vessels for light-water nuclear reactors. Chapter 3.** Amano, M.; Ando, E. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). pp 61-90 of Developments in pressure vessel technology - 3. Materials and fabrication. Nichols, R.W. (ed.). London, England; Applied Science (1980).

The present status of fabrication techniques for large and heavy pressure vessels to be used for the reactor vessels of light-water nuclear plant has been reviewed. Workshops with large capacity can fabricate the large completed vessels as heavy as approximately 800 tons to meet the stringent quality requirements relevant to this application. Various problems relating to heat treatments and to weld crackings which are inherent in heavy section steels have been solved after extensive investigations by research laboratories, and the resulting advanced techniques have been applied to the actual fabrication. To assure the quality of the completed vessels, the quality must be confirmed at each step of design, procurement and fabrication.

1884 **Vibrations of the pressure suppression system of a boiling water reactor.** Goeller, B.; Hailfinger, G.; Krieg, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). pp 657-671 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Containments of boiling water reactors usually contain a pressure suppression system. Steam escaping from the primary coolant circuit will condense in the water pool of the pressure suppression system, thus limiting pressure increases in the containment. Vibrations of the containment induced by these condensation processes, are investigated. After finite element calculations turned out to yield insufficient results, the dynamics of the spherical containment was investigated by a semi-analytical model SPHERI. In a next step the coupling between the structural dynamics and the three-dimensional fluid dynamics of the adjacent water pool was taken into account by the code SING-S. Here the fluid dynamics is described by a boundary integral method which then is used to modify the equations for the structural dynamics. The results show,

that fluid-structural coupling has a tremendous influence on the dynamic behavior of the containment. For model verification comparisons with full-scale condensation experiments at the Brunsbuttel power plant are used.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 1882, 1883, 2056, 2066, 2281

1885 (EUR—6813(Vol.1), pp 635-644) **Deposited activity on power plant primary coolant circuit wall measurements. Dose rate calculation.** Beslu, P.; Eimeicke, R. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Eau). 1980. (In French). Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Knowledge of the amount and distribution of activity in the primary coolant circuit of a power reactor is of great practical importance to reduce radiation exposure of operating personnel. Computer codes were studied to interpret observations and measurements on reactors, to forecast fission and contamination product activity and their evolution and to get a better understanding of basic physico-chemical phenomena. This paper develops the activity determination of water in the primary circuit and the deposited activity at the end of each cycle, on different parts of the primary circuit giving the measurement principle, the operating method and measurement qualification in power reactors (Ardennes, Beznau and Tihange reactors).

1886 (IA—1356, pp 271) **Reliability analysis of an auxiliary feedwater system of a PWR. A comparative study.** Zell, E.; Ilberg, D. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

1887 (INIS-mf—6528, pp 308-311) **Corrosion product transport in nuclear power plant equipment.** Horvath, L.G. (Villamosenergiaipari Kutato Intezet, Budapest (Hungary)); Snellman, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A model for activity build-up and mechanism for corrosion product generation and transport in pressurized water reactor systems is described, including the acting physico-chemical factors, such as the soluble and particulate form of corrosion products. The pH has been identified as one of the major influencing factors. The presented model explains some of the differences of the existing theories.

1888 (INIS-mf—6528, pp 217-218) **Tasks and methods of radiochemical laboratories at nuclear power plants.** Schunk, J.; Bogancs, J.; Pinter, T. (Paksi Atomeroemue Vallalat, Paks (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The main tasks and methods applied in radiochemical laboratories of nuclear power plants are discussed, namely the checking of the conditions of active zone and equipment on the basis of the activity of radioactive nuclides to be found in the heat-carrier, the checking of the water norms of the heat-carrier based on inactive water-analytical measurements and the checking of the tightness of fuel-elements under operation and refuelling.

1889 **Analysis of the hydrodynamic stability of natural circulation.** Olive, J.; Baby, J.P. (Electricite de France, 75 - Paris). pp 169-175 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

A mathematical model (EOLE) for the analysis of the stability of boilers with natural circulation is discussed. The method employed consists in linearizing one-dimensional flow equations and in integrating them while employing the Laplace transformation. The properties of a two-phase fluid are schematized by a homogeneous model with slip. The computation results in the circulation loop transfer functions and its natural modes of oscillation (frequency and damping). A discussion follows which compares results obtained with this method to those of other existing models in the case of a straight pipe with forced circulation. Agreement proved to be satisfactory. The results are then given of a parametric study involving the stability of a PWR natural circulation steam generator. These results show that the model can satisfy, at least qualitatively, trends observed empirically or obtained with other more complex theoretical models.

1890 **Peach Bottom 2 turbine trip analysis.** Lu, M.S.; Cheng, H.S.; Hsu, C.J.; Diamond, D.J.; Shier, W.G.; Levine, M.M. (Brookhaven National Lab., Upton, NY (USA)); Odar, F. (Nuclear Regulatory Commission, Washington, DC (USA)). pp 51-59 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

An analysis of recent BWR turbine trip experiments is presented. The analysis was performed by means of the two-dimensional (R,Z) core dynamics code BNL-TWIGL in conjunction with the system transient code RELAP-3B. Using the core power history measured during the tests, RELAP-3B first calculates the system thermal-hydraulics to provide the time-dependent core inlet conditions as input to BNL-TWIGL. BNL-TWIGL then performs a space-time analysis of core neutronics and thermal-hydraulics with feedback. The calculated power history was then compared to the measured as the basis of qualification. Good agreement was obtained, thus confirming the validity of the basic models of the two codes.

1891 **U-tube steam generator dynamics modelling and verification.** Bruens, N.W.S. (Technische Hogeschool Delft (Netherlands)). pp 11-19 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

This paper deals with the description and verification of the non-linear HYSG-UNC model, developed for the simulation of the transient behaviour of vertical natural circulation U-tube steam generators used in pressurized water reactor plants. The model is implemented on a hybrid computer and verified by comparison with measurements obtained on the steam generator of the Biblis-A plant. Comparisons are also made with the non-linear UTSG model developed by GRS, F.R. Germany.

1892 **Experimental simulation studies of PWR U-tube steam generators.** Kalra, S.P.; Adams, G.; Duffey, R.B.; Lapson, W.; Lundberg, R. (Electric Power Research Inst., Palo Alto, CA (USA)). pp 9-76 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

About one-seventh scale model of PWR U-tube steam generator has been built for studying the thermal-hydraulic response of a prototypical system using fluid (Freon) to fluid (water) modeling and flow visualization techniques. The prototypical values simulated in these experiments are: (1) system pressure, 4.5 to 7 MPa, (2) thermal power, 700 to 1200 MW, (3) circulation ratio, 5 to 15, and (4) identical tube diameter and pitch-to-diameter ratio. The results based on fluid modeling and flow visualization in the steam generator are presented.

1893 **Flow instabilities in a once-through steam generator.** Nariai, H.; Kobayashi, M.; Matsuoka, T.; Ito, Y.; Aya, I. (Ship Research Inst., Tokyo (Japan)). pp 131-138 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Flow instabilities in the once-through steam generator for an integral type marine reactor were investigated with 0.8 MW test rig. Steady state thermo-hydraulic characteristics were experimentally derived and analyzed. The instability threshold was obtained for various combinations of parameters. The oscillations are typical parallel channel density wave oscillations. An analytical model for the instability threshold is proposed, with which the experimental results are well explained. The oscillations are both in the first and the second mode. The oscillation periods are closely related to the transit time of the fluid through the heating zone.

1894 **Simulation tools in CEA.** Bonnemay, A.; Delourme, D.; Drusch, P.; Samak, C (CEA, 75 - Paris (France)). pp 243-248 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Simulation packages for PWR plants may be conceived for different purposes: (a) design of plants, (b) prevision and/or accidental behavior studies, (c) normal operating area studies, and (d) control studies. Purposes (a) and (b) can be undertaken by means of a highly descriptive code, derived from physical properties of the plant, which is SIRENE. Purposes (c) and (d) are reached by means of a fast and flexible package which is PICOLO, in which a good accuracy is obtained by identification of a set of coefficients from comparison of results of PICOLO and SIRENE's ones. Details are given of both codes.

1895 **Dynamic modelling of nuclear steam generators.** Kerlin, T.W.; Katz, E.M.; Freels, J.; Thakkar, J. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). pp 249-258 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Moving boundary, nodal models with dynamic energy balances, dynamic mass balances, quasi-static momentum balances, and an equivalent single channel approach have been developed for steam generators used in nuclear power plants. The model for the U-tube recirculation type steam generator is described and comparisons are made of responses from models of different complexity; non-linear versus linear, high-order versus low order, detailed modeling of the control system versus a simple control assumption. The results of dynamic tests on nuclear power systems show that when this steam generator model is included in a system simulation there is good agreement with actual plant performance.

1896 **Automatic control of steam generator levels in EDF PWR units.** Miossec, C.; Tassart, J.; Irving, E. (Electricite de France, 75 - Paris). pp 299-307 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

In charge of the problems of PWR steam generator low load level control, EDF SEPTEN developed a numerical model allowing a good representation of the steam generator internal physics and showing the variation of dynamics in relation with various parameters. This and the Belgian starting experience of DOEL and TIHANGE units enabled the setting up of a control device for French units without any manual operation under normal zero load to full load transient conditions.

1897 **Toward efficient full automatic operation of the PWR steam generator with water level adaptive control.** Irving, E.; Miossec, C.; Tassart, J. (Electricite de France, 75 - Paris). pp 309-329 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Due to the problems of the automatic water level control from low load to full load, utilization of different adaptive control methods is presented in this paper after description of a simplified model of the level of the steam generator and analysis of the drawbacks of the classical controllers. The problems involved in the implementation of different adaptive control methods are described and finally a simplified adaptive control method is set out which avoids the different problems encountered.

1898 **Prediction of steady, three-dimensional flow in pressurized water steam generators.** Hulme, G.; Phelps, P.J.; Spalding, D.B.; Tatchell, D.G. (CHAM Ltd., Wimbledon (UK)). pp 397-405 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

A calculation procedure is described for three-dimensional flow and heat transfer in steam generators. Options are provided to calculate slip between the phases, and to treat the flow as homogeneous (i.e. phase velocities equal). Typical homogeneous-flow results are shown for a steam generator of the type used in pressurized-water reactors. The predicted effect of removing the flow-distribution plate is illustrated. These results, and others reported elsewhere, show that practical, three-dimensional predictions of steam generator flow phenomena can now be made. These can be utilized by designers and operators to: improve performance at the design stage by, for example, examining effects of flow-distributing devices on performance; analyze the effects of changes in operating conditions, or deterioration, which occur during use; or, examine the causes of failure in use, and the effectiveness of proposed cures.

1899 **PWR reactor pressure vessel failure probabilities.** Dufresne, M.J.; Lanore, J.M. (CEA, 75 - Paris (France)); Grandemange, J.; Pellissier-Tanon, A.; Quero, J. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)); Lucia, A.C.; Elbaz, J.J.; Brunnhuber, R. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). pp 37-44 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineerng Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Two methods have been developed in the past to evaluate the rupture probability of a LWR vessel: (1) A statistical approach using data from conventional plants. Since different standards have been used in manufacturing the vessels this method is questionable. (2) A probabilistic method using the fracture mechanics in probabilistic form. This method has been proposed previously but it appears that more accurate evaluation is possible. The latter method has been the object of a joint collaboration agreement signed in 1976 between CEA, EURATOM, JRC ISPRA and FRAMATOME, which set up and started a research program covering three parts: (i) a computer code development, (ii) data acquisition and processing, and (iii) support of an experimental program which aims at clarifying the most important parameters used in the computer code. This paper gives details of the program under the headings: presentation of the computer code; distribution and sizing of defects; fracture analysis.

1900 Elastic plastic strain correction factor in stainless steel pipes and nozzles subjected to thermal shocks. Prost, J.P. (Framatome, Paris (France)); Arnaudeau, F. (Novatome Industries, 92 - Le Plessis-Robinson (France)). pp 223-227 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

An elastic plastic strain correction factor is investigated numerically for two PWR nozzle configurations under thermal shock, using simplified models: cylinders subjected to a through-thickness temperature gradient and a cylinder clamped at one end in a rigid wall with a mean temperature differing from the mean wall temperature. Different stainless steel mechanical properties are considered. The results are compared with strain correction factors obtained for similar situations.

1901 Advanced accuracy evaluation of the finite element stress analysis performed on the integral vessel. Laurent, P.; Henin, R.; Collete, J.P.; Scailteur, A.; Widart, J. (Cockerill, S.A., Seraing (Belgium)). pp 309-317 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The paper presents the main characteristics of the Integral Vessel and its application to a wide range of reactor vessels. Improvement of the stress distributions are pointed out by a representative stress analysis: stress results give a more complete view of the stress behaviour of the vessel. Applied to some load case analysis, an advanced accuracy evaluation method is presented. Applications of that method show how easily and how completely the method can improve the computational work accuracy.

1902 Evaluation of fracture mechanics material parameters for the reactor pressure vessel steel 22 NiMoCr 3 7 from WOL X-specimens. Blauel, J.G.; Hollstein, T. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg (Germany, F.R.)); Wenk, M. (Technischer Uberwachungsverein Norddeutschland e. V., Hamburg (Germany, F.R.)). pp 43-55 of Assuring structural integrity of steel reactor pressure vessels. Steele, L.E. (Naval Research Lab., Washington, DC (USA)); Stahlkopf, K.E. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Systems and Materials Dept.) (eds.). London, England; Applied Science (1980).

From 1. international seminar on assuring structural integrity of steel reactor pressure vessels; Berlin, F.R. Germany (20 Aug 1979).

Wedge open loaded (WOL) 25 X-type specimens are used in standard irradiation surveillance programmes of German pressurised light water reactors to deliver values of the fracture toughness Ksub(Ic) for a brittle fracture analysis. To cover a maximum range of values with WOL 25 X-specimens the methods of elasto-plastic fracture mechanics are investigated in this programme. Having in mind the application for irradiated standard WOL 25 X-specimens a single specimen procedure is developed to evaluate critical values of the energy integral J. A direct current potential method is successfully used to determine the values of load Fsub(i) and load-line displacement Vsub(gi) sup(L) for first crack advance. Critical values Jsub(i) are then converted into critical stress intensity factors K sub(Ji). Such elasto-plastic values Ksub(Ji) for a specially heat treated plate of the reactor pressure vessel steel 22 NiMoCr 3 7 are compared to a Ksub(Ic)(T)-curve derived from WOL X-specimens with thicknesses up to 200 mm according to ASTM E 399. Within the scatter of the material properties the Ksub(Ic)(T)-curve can well be verified by testing WOL 25 X-specimens and using an elasto-plastic evaluation. This is investigated up to a Ksub(Ic)-level of 140 MN/ msup(3/2) at about room temperature.

1903 Strain ageing sensitivity of pressure vessel steels and welds of nuclear reactor components. Houssin, B.; Slama, G. (Framatome, Paris-La-Defense (France). Material Dept.); Moulin, P. (Societe Creusot-Loire, Le Creusot (France)). pp 57-67 of Assuring structural integrity of steel reactor pressure vessels. Steele, L.E. (Naval Research Lab., Washington, DC (USA)); Stahlkopf, K.E. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Systems and Materials Dept.) (eds.). London, England; Applied Science (1980).

From 1. international seminar on assuring structural integrity of steel reactor pressure vessels; Berlin, F.R. Germany (20 Aug 1979).

The sensitivity to strain ageing embrittlement of low alloy steels and welds (SA 508 Cl.3, SA 216 WCC, deposited metal and HAZ) encountered in a pressure vessel of the primary circuit of PWR was investigated using Charpy V notch impact tests. Except for the as-welded deposited metal, the metallurgical structures were found slightly sensitive to strain ageing which induces an embrittlement characterised by a 10 to 20°C shift of the transition temperatures from the 5% strained condition. On the other hand, the deposited metal in the as-welded condition exhibits a large sensitivity to strain ageing which was attributed to a high content of free interstitial atoms, mainly nitrogen, in this metallurgical state. The sensitivity to strain ageing of the weld metal is modest in the 615°C postweld heat-treated condition which lowers the interstitial content by precipitation of carbides, nitrides and nitrocarbides. A postweld heat treatment performed after ageing induces a large recovery of the initial impact properties. No noticeable embrittlement by strain ageing yas been found on the 1.5% strained condition. Ageing heat treatment under stress (200 MPa) and long duration ageings (4500h) did not modify the magnitude of embrittlement observed for the 300°C.

1904 Predictions of hydrodynamic vibrations for some cylindrical structures of nuclear reactors in contact with the heat-transferring fluid. Milan, D.; Berthollon, G. (Hydraulic Lab., B.V.S. Creusot-Loire, Grenoble, France); Parras, F.; Dubourg, M. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). pp 399-408 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

This paper deals with the study of the vibratory behaviour of thin cylindrical structures under the turbulence of the heat transferring fluid. These simple structures constitute an idealization, often adequate, of several structures used in nuclear hydraulics. It is shown that an empiric representation of the excitation spatial field makes it possible, in the experimented cases, to predict with a fair accuracy the vibratory response of the first modes. The cases of application of such an approach are discussed.

1905 Influence of boundary conditions and co-vibrating liquid on frequency spectrum of a model of the spheric bottom of the supporting cylinder of a PWR reactor. Kulovany, F. (National Research Institute for Machine Design, Prague, Bechovice, Czechoslovakia). pp 385-397 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Results are presented of an experimental and theoretical determination of vibration properties of a model of the hollow spheric bottom of the supporting cylinder of the PWR reactor, in air as well as in still water medium. The results are presented of an experimental study of the replacement of seating of the spheric bottom edge, and of the measurement and calculation of the frequency spectrum of the model for vibration in the axisymmetric modes, including the approximate values of the damping coefficient. The results have been discussed and compared with results obtained theoretically.

1906 **Study of the vibrational behaviour of the vessel and internals of the Fessenheim 1 PWR - application to vibrational monitoring.** Jaudet, A.; Sol, J.C. (Electricite de France, 92 - Clamart. Direction des Etudes et Recherches). pp 749-753 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The progress achieved in respect of a study entered upon by Electricite de France (EDF), on the monitoring by vibration analysis of the mechanical state of a nuclear vessel and its internals is described. This monitoring involves being able to correlate the frequency characteristics of the vibrations to possible alterations of some mechanical parts. For that, tests were effected on the site, to confirm the computation modelling. This validation has made possible a theoretical simulation of some potential failures (flexures, ruptures, for instance).

1907 **PWR fuel assembly dynamic characteristics.** Stokes, F.E. (Babcock and Wilcox Co., Alliance, OH (USA). Research Center); King, R.A. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). pp 27-45 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

A pressurized water reactor fuel assembly is subjected to flowing water conditions causing vibration of the assembly. The purpose of this program was to evaluate the fuel assembly design from a dynamic standpoint by performing various tests on beginning-of-life and end-of-life prototype fuel assemblies. The primary dynamic characteristics of the fuel design were determined from tests performed in air and water, under both cold and hot water reactor operating conditions. The following parameters were investigated to determine their effect on the fuel assembly dynamic characteristics: fuel rod grip forces, temperature, environment, flow velocity, vibration amplitude, vibration direction, and control rod insertion.

1908 **Inservice inspection of 'system 80'sup/TM/ nuclear steam supply systems.** Selig, B.J. (Combustion Engineering, Inc., Chattanooga, TN (USA)). pp 1-7 of Periodic inspection of pressurized components. Discussion volume. Conference originally held London, 8-10 May 1979. London, England; Mechanical Engineering Publications for The Institution of Mechanical Engineers (1979).

From Conference on periodic inspection for pressurized components; London, UK (8 May 1979).

This paper describes efforts to enhance inservice inspectability in modern nuclear steam supply system designs. Utilizing the primary components designers' broad experience in both inservice inspection and vessel fabrication, new vessel designs reflect fewer required weld inspections. The result is improved refueling outage times, reduced manrem exposures and decreased inspection costs.

1909 **Disperseness of radioactive aerosoles at a NPP and deposition of aerosol particles in sampling tubes.** Grigorov, V.P.; Chernyi, S.S. pp 53-58 of Radiatsionnaya bezopasnost' i zashchita AEhS. Vypusk 3. Egorov, Yu.A.; Mashkovich, V.P.; Pankrat'ev, Yu.V.; Tsypin, S.G. (eds.). Moscow, USSR; Atomizdat (1977). (In Russian)

To advance gaseous effluents cleanup systems and evaluated the efficiency of air sampling the investigations of radioactive aerosol disperseness in the main ventilation systems of the Novovoronezh NPP unit 3 and 4 have been performed. The measurements are implemented with a 6-cascade impactor (the sixth cascade is the AFA-RMP fileter) with substrates coated with a thin layer of the AFA-V filter. The air sampling is undertaken during 4-5 hrs at the air flow rate through the impactor of 10-15 l/min. The particle radioactivity and mass distributions over their aerodynamic dimameters have proved to be fitted well by the logarithmic normal distribution function. The activity relationship between different aerosol fractions does not change after 5 hr holdup. The degree of radioactive aerosol deposition kappa in an air sampler has been calculated and occurred to equal 0.679. The calculated kappa value has been verified experimentally and proved valied.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 2040, 2041

1910 **Fission product release from bare HTR-fuel kernels during storage at room temperature.** Reitsamer, G.; Falta, G. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Forschungszentrum); Mehner, A.W. (Hochtemperatur-Reaktor-Brennelement G.m.b.H. (HOBEG), Hanau (Germany, F.R.)). pp 149-154 of Post-irradiation examination. London, England; British Nuclear Energy Society (1981).

From British Nuclear Energy Society conference; Grange-over-Sands, UK (13 May 1980).

Coated particles from various HTR-fuel elements were separated into kernel and coatings and stored at room temperature. A significant loss of fission products (cesium, rubidium) from some of the dense kernels was observed after a storage time of a few weeks. It could be proved that this post irradiation release effect is caused only by humidity. Results from gamma spectrometric measurements of the released fraction at stepwise increasing humidity are presented. SEM-photos demonstrate the formation of fission product crystals on the surface of some of the fuel kernels. A model describing the release mechanism is proposed.

1911 **Application of a two-dimensional boiler model to design and operational problems in AGR and Magnox power stations.** Balfour, J.D.; Fallows, T.; Gane, C.R.; Jones, R.C.; Lis, J.; Preece, J. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.); Gill, G.M. (Central Electricity Generating Board, Manchester (UK). Scientific Services Dept.). pp 95-103 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Operational problems encountered in two different once-through boilers have been investigated using the two-dimensional steady-state boiler model CROSSMIX. The first case concerns a severe mal-distribution of feed flows in a Magnox station boiler operating with a number of water passes blanked off. The model was used to assess the existing situation and then to evaluate the feed ferrule distribution required to restore the operating conditions to the design level. Measurements of the individual tube flow rates made at the start of the investigation and after re-ferruling were found to be in good agreement with the model predictions. A similar operational situation with blanked off tubes in one unit of an AGR boiler provided an opportunity for an assessment of the effective gas thermal mixing which should be used in CROSSMIX for a section of the boiler characterised by very low values of turbulent Peclet number. CROSSMIX was then used in conjunction with the dynamic model SPOTS to evaluate conditions ensuring the stability of water/ steam flows in another unit of this boiler operating with a number of defective feed inlet orifices. The application of CROSSMIX to the design of boilers is illustrated by an investigation of the effects of inlet feed throttling on the sensitivity of a once-through boiler to perturbations in boundary conditions such as gas inlet temperature profile, heat losses through the walls, heat transfer coefficients, water/steam side friction factors, blanked off tubes, etc. It is shown that the inlet impedance required to ensure the static and dynamic stability is also near the optimum for reducing the boiler sensitivity.

1912 **Feed flow limit cycling in AGR boilers.** Green, C.H.; Lightfoot, P.; Deam, R.; Chojnowski, B. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). pp 117-124 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Transgression of dynamic stability thresholds in boilers gives rise initially to linear growth of tube to tube feed flow oscillations followed by non-linear behavior resulting ultimately in limit cycling. The nature of the limit cycle determines the amplitude of tube temperature cycling and hence the stress level to which the boiler structure is subjected if operated under unstable conditions. This paper explores the underlying physical mechanisms leading to limit cycling by applying the NUMEL suite (namely NUMEL, DYMEL and the reverse flow code TAMOC) to analysis of available plant and experimental data relating to AGR boilers under start-up conditions. An outline is given of the method of characteristics solution scheme incorporated in TAMOC.

1913 **Tube to tube excursive instability: sensitivities and transients.** Brown, M. (Central Electricity Generating Board, Harrogate (UK). Scientific Services Dept.); Layland, M.W. (Central Electricity Generating Board, Barnwood (UK). Generation Development and Construction Div.). pp 151-158 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

A simple basic analysis of excursive instability in a boiler tube shows how it depends upon operating conditions and physical properties. A detailed mathematical model of an AGR boiler is used to conduct a steady state parameter sensitivity survey. It is possible from this basis to anticipate the effects of changes in operating conditions and changes in design parameters upon tube to tube stability. Dynamic responses of tubes operating near the stability threshold are examined using a mathematical model. Simulated excursions are triggered by imparting small abrupt pressure changes on the boiler inlet pressure. The influences of the magnitude of the pressure change, waterside friction factor, and gas side coupling between tubes are examined.

1914 **AGR design and simulator reference dynamic total plant models.** Dulson, P. (Central Electricity Generating Board, Barnwood (UK). Generation Development and Construction Div.). pp 233-242 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

The AGR dynamic total plant models have been written for design and simulator reference purposes. Initial confidence in the models was established by comparing constituent modules, particularly reactor and boiler, with existing reference codes and rig results. The models have subsequently been employed for a variety of applications and further confidence is being established by validation against results from the operating AGR stations.

1915 **Gas cooled reactor plant once-through steam generator dynamics. Mathematical model and construction principles of steam generator automatic control system.** Chernov, A.G.; Kuts, F.M.; Ostrovsky, L.A.; Pleshkov, V.E.; Polumordvinova, I.G. (The All-Union Nuclear Power Engineering Research and Development Institute, Moscow (USSR)). pp 335-345 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

The gas cooled nuclear power plant model for small disturbances has been developed. The model is based on the structural principle and describes the plant elements as an object with distributive parameters. With the help of the given model it became possible to study the dynamic characteristics of the plant. Control scheme variants are considered. The research has shown that the disturbance may be dangerous in case the high pressure heater is cut off.

1916 **NUMEL: a computer-aided design suite for the assessment of the steady state, static-dynamic stability, and transient responses of once-through steam generators.** Lightfoot, P.; Deam, R.T.; Green, C.H. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.); Rea, J. (Central Electricity Generating Board, Bristol (UK)). pp 347-355 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

NUMEL is a suite of computer codes for modelling the steady state, static/dynamic stability, and transient responses of once through monotube nuclear boilers. At first, validation is carried out against data from transient tests conducted on an electrically heated high pressure boiler rig and from an AGR power station boiler. A technique is presented for obtaining a linearized frequency response from a non-linearized model. It is used to compare the predictions of NUMEL with an analytic frequency response for a simplified boiling system and with a specialist frequency response code. NUMEL is shown to perform well in all the comparison exercises.

1917 **DYMEL code for prediction of dynamic stability limits in boilers.** Deam, R.T. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). pp 357-364 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Theoretical and experimental studies of Hydrodynamic Instability in boilers were undertaken to resolve the uncertainties of the existing predictive methods at the time the first Advanced Gas Cooled Reactor (AGR) plant was commissioned. The experiments were conducted on a full scale electrical simulation of an AGR boiler and revealed inadequacies in existing methods. As a result a new computer code called DYMEL was developed based on linearisation and Fourier/Laplace Transformation of the one-dimensional boiler equations in both time and space. Beside giving good agreement with local experimental data, the DYMEL code has since shown agreement with stability data from the plant, sodium heated helical tubes, a gas heated helical tube and an electrically heated U-tube. The code is now used widely within the UK.

1918 **Technique for estimating steady state temperature variation tube-to-tube within an AGR boiler from measurements external to the pressure vessel.** Morris, A.W.L. (Central Electricity Generating Board, Bristol (UK)). pp 379-389 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

In order to ensure adequate tube life, the steam/metal temperatures at a critical location within the boilers of Advanced Gas Cooled Reactors must be maintained between minimum and maximum temperature limits. Under certain circumstances, direct interpretation from the thermocouples installed for monitoring this location can give unrepresentative results. Statistical relationships have been developed, based on temperature measurements external to the pressure vessel and a knowledge of the prevailing boiler operating condition, which enable improved estimates of temperatures at this critical location to be made.

1919 **Commissioning of AGR boiler control systems.** Warne, P. (Clarke Chapman-John Thompson Ltd., Gateshead (UK)). pp 419-426 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

The Operations Department of NEI Clarke Chapman Power Engineering Ltd. acquired considerable practical experience in Nuclear Boiler Control whilst commissioning the first British Commercial AGR Boilers. This experience is reviewed, with reference both to the alterations imposed upon boiler and control system performance between the times of tender and synchronization, and also to the influence of plant performance and mechanical components upon control system capability. Where possible, conclusions are drawn from this experience in order to illustrate improvements which could be made to future AGR Boiler Control Systems.

1920 **Acceptance criteria for weld defects in the hotbox dome of an advanced gas-cooled reactor.** Tate, L.A.; Rigg, G.J. (Nuclear Power Co. Ltd., London (UK)). pp 7-16 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Recent developments in failure assessment methodology have emphasized that failure of a structure is bounded by two limiting conditions: (1) where failure is controlled by crack-tip properties and events, (2) where failure is controlled by the properties of the uncracked ligament. The former situation is evaluated using the techniques of linear elastic or post-yield fracture mechanics, as appropriate, and the latter case using, for example, plastic limit analysis. This paper presents the results of an exercise to evaluate quantitatively the conditions leading to failure by collapse, deformation or fast fracture in a complex structure known as the hot box dome. The results show clearly the need to include both collapse and deformation as potential failure modes in a defected structure. Previous published work on 'two criteria' approaches have generally considered fast fracture and collapse only, whereas for the conditions considered in this paper the lowest value of critical defect size was associated with the deformation mode, for one of the three welds considered.

1921 **Determination of the noise transmission characteristics of the Hartlepool AGR fuel channel using cross spectral analysis techniques.** Shaw, D.C. (Nuclear Power Co. (Whetstone) Ltd. (UK)); Williams, R. (SDRC Engineering Services (UK-SCAN) Ltd., Hitchin (UK)). pp 101-114 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Vibrations in nuclear plant, e.g. thermal insulation coverplates, can be induced by high intensity noise within the gas circuit. Measurements have been made of the acoustic transmission characteristics of a fuel channel using a full scale model. Since the test fuel channel constituted one limb of a closed loop gas circuit, it was possible for noise from the circulator to be simultaneously propagated in two directions, i.e. with or against the flow. In order to determine the reactor fuel channel acoustic transmission characteristics the contributions from each direction of noise propagation were separated using cross spectral density and coherence functions.

1922 **Flow induced vibration of AGR heat exchanger tubes.** Welbourne, M.C. (Clarke Chapman Ltd., Derby (UK)). pp 297-305 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

This paper describes the development work carried out to estimate the flow induced vibrating forces and response of a bank of low finned A.G.R. heat exchanger tubes assembled in a staggered formation, where XL = 2.77, XT = 1.6. Tests carried out on two rigs are described, the first, an atmospheric rig was designed to simulate a section of a full size heat exchanger complete with tubes, supports and return bends. The second was a smaller rig representing a section of tubes between supports. It was fitted in a pressurised wind tunnel and used to investigate vibrations at high Reynolds numbers.

1923 **Calculation of the response of thermal insulation cover plates to gas turbulence.** Earl, P.G. (Nuclear Power Co. (Whetstone) Ltd. (UK)). pp 435-444 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

By use of a mathematical model it has been possible to predict the turbulence induced stresses in the retention systems of the various cover plate designs, of the Dungeness 'B' AGR concrete pressure vessel thermal insulation, by extrapolation of experimented results from response tests on a particular design of cover plate. This paper outlines the analytical approach including the evaluation of the correlation length of the turbulence (the coupling parameter between the turbulence and cover plate motion).

1924 **Vibration problems associated with AGR thermal insulation.** Bickers, B.H. (Nuclear Power Co. (Whetstone) Ltd. (UK)). pp 445-454 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

A programme is described of theoretical and experimental work undertaken to ensure that the thermal insulation lining the concrete pressure vessel of the Dungeness 'B' Advanced Gas-Cooled Reactor would withstand the prevailing noise and turbulence levels over the station lifetime. The methods of designing the insulation to withstand the particular spectrum generated by the Dungeness circulators are described together with the steps taken to resolve the conflicting design requirements for vibration, thermal performance and loading due to thermal cycling. The most important aspects of design for acceptable vibration levels are covered in the paper and illustrated with examples of typical test results.

1925 **Vibration problems associated with instrumentation cables in the reactor environment.** Sun, M.P. (Nuclear Power Co. (Whetstone) Ltd. (UK)). pp 455-465 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Some of the vibration problems associated with stainless instrumentation cables in the reactor environment are described. The results of an extensive programme of test work are analysed and it is found that for the Dungeness AGR, specific designs of cable configurations must be followed to keep stresses within fatigue limits. Some amplified general expressions are derived for cable vibration from a combination of theory and measurements.

1926 **Flow induced pressure fluctuations in hot gas ducts of a high temperature reactor.** Achenbach, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). pp 467-475 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The fluctuating wall pressure in straight tubes and several types of bends are experimentally investigated. The Reynolds number was varied from $Re = 3 \times 10^3$ up to $Re = 2 \times 10^6$. It is shown that the intensity of the pressure fluctuations can be corre-

lated with the mean flow quantities, ie with the dynamic pressure and the pressure drop coefficient. The intensity spectrum is flat at low frequencies. Exceeding a characteristic frequency fsub(c), a considerable decrease of the intensity is observed. The Strouhal number, Ssub(c), formed with fsub(c), the bend diameter and the mean velocity is independent of the Reynolds number and has a value of S = 1,32 +- 0,12.

1927 **Hinkley Point 'B' fuel assembly vibration problems - a broad perspective.** Joss, J.O.; Emsley, G.M.; Hardingham, R.P. (Nuclear Power Co. (Risley) Ltd. (UK)). pp 499-505 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The problem of severe damage due to vibration in a number of Hinkley 'B' fuel channel units at a late stage of commissioning, has been given top priority in the UK nuclear industry. Initial examination showed that a small number of upper gag units had suffered extensive mechanical damage, including hammering and erosion of the gag plug and/or its drive shaft. Further examination disclosed that a number of bellows had developed cracks in their internal shrouds used to stream-line the gas flow through the bellows sections. The programme of work on the gag plug and bellows shroud is given.

1928 **Evolution of the modifications designed to suppress the damaging vibration of the Hinkley Point 'B' and Hunterston 'B' gags.** Bolton, A.D.; Furber, B.N. (Nuclear Power Co. (Risley) Ltd. (UK)); Parkin, M.; Walton, H. (UKAEA Windscale Nuclear Power Development Labs.). pp 507-522 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Some AGR adjustable gags, which match the gas flow in every channel to the channel heat output, have been found to vibrate and fail during commissioning tests. In searching for a solution to the problem, orifice profile modifications, fin and orifice venting and bias force stabilisation were studied, and modifications made on the basis of the results.

1929 **Investigation of fatigue cracking of gimbal joint bellows shrouds on the Hinkley Point 'B' fuel channel gag unit.** Sansom, K. (UKAEA Springfields Nuclear Power Development Labs.); Hopkins, I.H.G. (Nuclear Power Co. (Risley) Ltd. (UK)). pp 523-547 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Cracking of the stainless steel shrouds fitted inside the gimbal joints in the lower section of the Hinkley Point 'B' fuel channel gag unit was discovered during examination of gag units discharged because of excessive vibration during reactor commissioning. The cracking was shown to occur within a few hours at reactor flow conditions and to be unrelated to the gag failures. The vibration response of the shrouds was examined in flow and acoustic tests using full-scale pressurised rigs and atmospheric air rigs, and the cracking was shown to result from an aero-elastic vibration. An improved shroud design was developed to prevent cracking, and modifications were also made to two spiders in the plug unit to eliminate whistles generated by periodic eddy shedding from the trailing edge of the spider arms.

1930 **Vibration endurance testing of the Hinkley Point 'B' fuel plug unit.** Blairs, W. (Nuclear Power Co. (Risley) Ltd. (UK)); Guiver, D.W. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.); Sansom, K.A. (UKAEA Springfields Nuclear Power Development Labs.). pp 549-576 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Fuel channel gag failures were experienced on Hinkley 'B' AGR during the final reactor trials leading up to power raising. A major test programme was initiated to investigate the problem and to find and demonstrate an adequate solution. The various ways in which the vibration endurance of the fuel plug units was investigated is described. Complete assemblies were tested both in pressurised rigs and in extended runs on a reactor undergoing commissioning, and component parts were tested in air in the laboratory. The unusual step of using a power reactor as a test facility was taken because it enabled a statistically large sample to be tested simultaneously, a major factor in the gag problem being the variation in stability from unit to unit, due to minor dimensional differences. In all the tests conducted, the results indicated that the final gag design would have a satisfactory life of at least one fuel dwell of 5 years.

1931 **Vibration mechanisms associated with annular flow through a flow control device.** Denton, J.D.; Hutton, M.F. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.); Parkin, M.W. (UKAEA Windscale Nuclear Power Development Labs.). pp 577-588 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The flow processes involved in the control of a gas stream by the imposition of a gag formed from a centrebody in an orifice is described. It is demonstrated in the case of the Hinkley Point 'B' gag that the original stabilising forces may be overcome by simple asymmetries in the geometry. The effect on the flow of the movement of the centrebody in the orifice is to modify the pressure distributions such that an energy input is provided to sustain that movement. The mechanisms of flow modification include combinations of flow hysteresis, acceleration and deceleration of the local flow and spoiling of diffusion by the local introduction of additional flows. The importance of the individual components is examined and it is concluded that the processes involved are general in their application.

1932 **Vibration data and its employment for component life projections in AGR circulators.** Chivers, T.C.; Gordelier, S.C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.); Roy, J. (Central Electricity Generating Board, Barnwood (UK). Generation Development and Construction Div.); Wharton, M. pp 685-700 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Potential plant failures from excessive vibration are categorised into three groups; control failures and fatigue failures. Advanced Gas Cooled Reactor gas circulators are described, and the wear of the dome closure components for some encapsulated designs examined as an example of a vibratory wear failure. It is shown that the vibration and tribological examinations each provided evidence to assist the other discipline, and it is argued that only by a combination of this expertise could a realistic assessment of component life have been achieved. From this specific example general conclusions are drawn for the advantages of discipline interaction in assessing vibratory wear failures.

1933 **Application of external vibration monitoring to reactors with concrete pressure vessels.** Hammill, W.J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). pp 755-770 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The application of external vibration monitoring techniques to advanced gas cooled reactors (AGR) which have concrete pressure vessels is considered. A monitoring system for a particular

AGR coolant circuit structure is developed, whose primary objective is to detect impacting of two components, although the detection of forced vibration response is also considered. Experimental results from instrumented components in the reactor and data from rig tests on full size units have been used together with a mathematical model of some elements of the transmission path in order to establish its dynamic characteristics and relate internal component vibration to externally measured signals. The application of external vibration monitoring to the external detection of the forced vibration response of an internal reactor assembly and the remote monitoring of circulator sound output is discussed.

1934 **Measurement of heat exchanger vibration during reactor operation.** Whitton, P.N.; Durrans, R.F. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). pp 771-787 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Measurements of economiser tube vibration have been made at Wylfa Power Station as part of a programme to investigate the vibration behaviour of the boilers following a number of tube leaks from fretting between tube and support. Measurements have been made under isothermal conditions appropriate to reactor commissioning and also during on-load operation. The measured responses are compared to highlight both the limitations and attractions of isothermal commissioning tests.

1935 **Acoustically induced response of reactor thermal insulation at low frequencies.** Whitton, P.N. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). pp 801-814 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The response of insulation assemblies to sound is considered, and in particular the behaviour in the lower modes. Experimental confirmation of the theoretical results are reported using simulated insulation assemblies excited in a reverberant sound field. It is shown that response increases with the irregularity of cover plate shape and attachment arrangements, and that large variations in response with spatial position in a cavity are possible. Consideration is also given to the sound radiation from the back face of the coverplate in contact with the insulant. The results are important when extrapolating measurements made on insulation specimens in air to reactor conditions.

1936 **Prediction of sound pressure levels in the primary coolant circuit of Dungeness 'B' AGR.** Matthews, L.J. (Nuclear Power Co. (Whetstone) Ltd. (UK)). pp 815-831 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The sound pressure levels in the Dungeness 'B' gas circuit used for structural component design were predicted using a 0.305 scale circulator model tests, together with calculations for those parts of the circuit not covered by the model. These predictions are presented together with sound pressure levels obtained from full size circulator runs in atmospheric air. The model and full size tests were carried out with and without absorber. Good agreement was obtained between the model and full size results, but the high proportion of energy in the blade passing frequency caused standing wave effects to complicate microphone readings. Running the circulator away from the design conditions resulted in an increase in sound pressure levels.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 2055, 2060, 2068

1937 (IWGFPT—8, pp 182-199) **Effects of irradiation on the iodine-induced stress corrosion cracking of CANDU Zircaloy fuel cladding.** Wood, J.C.; Kelm, J.R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1981. Dep. NTIS (US Sales Only).

From Specialists' meeting on pellet-cladding interaction in water reactors; Roskilde, Denmark (22 Sep 1980).

After adding a small quantity of iodine to Zircaloy tubes, formerly irradiated as the cladding of CANDU fuel rods, they were pressurized with argon and heated to 613 K. It was found that the time taken for a stress corrosion crack to penetrate the cladding wall at hoop stresses of 170-310 MPa was substantially less than in similar tests of unirradiated cladding. The strain attained by the irradiated tubes at hoop stresses of 170-310 MPa was generally less than 1% which is typical of strains measured in the cladding of defective fuel rods after power ramping. Unirradiated tubes reached strains up to 16% for hoop stresses up to 310 MPa. Irradiated CANDU cladding with a thin layer of graphite on the inside tube surface survived for longer times than irradiated (bare) LWR cladding subjected to similar pressurized tube SCC tests at stresses approximately <300 MPa. Arguments are presented that this difference is not attributable to differences in the experimental variables: iodine concentration, temperature and fast neutron fluence.

1938 **Development and verification of a space-dependent dynamic model of a natural circulation steam generator.** Mewdell, C.G.; Harrison, W.C.; Hawley, E.H. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment); Durmont, R.S.; Green, G.H. (Regina Univ., Saskatchewan (Canada)). pp 35-45 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October 1979. London, England; British Nuclear Energy Society (1980).

This paper describes the development and verification of a Non-Linear Space-Dependent Dynamic Model of a Natural Circulation Steam Generator typical of boilers used in CANDU nuclear power stations. The model contains a detailed one-dimensional dynamic description of both the primary and secondary sides of an integral pre-heater natural circulation boiler. Two-phase flow effects on the primary side are included. The secondary side uses a drift-flux model in the boiling sections and a detailed non-equilibrium point model for the steam drum. The paper presents the essential features of the final model called BOILER-2, its solution scheme, the RD-12 loop and test boiler, the boiler steady-state and transient experiments, and the comparison of the model predictions with experimental results.

1939 **Progress review of Ontario Hydro's nuclear generation and heavy water production programs.** Bate, D.L.S.; Popple, R.T. (Ontario Hydro, Toronto (Canada)). pp 11-42 of 20. annual international conference. Toronto, Ontario; CNA (1980).

From Annual conference of the Canadian Nuclear Society; Montreal, Quebec, Canada (18 Jun 1980).

Ontario Hydro had a total installed electrical capacity of 23 968 MW at the end of 1979, with 5 248 MW supplied by nuclear plants. The nuclear generating units in service were at NPD GS (22MW), [Douglas Point GS (206MW), Pickering GSA (4x515MW),] and Bruce GS A (4x740MW). The total nuclear capacity under construction was 8 600 MW. In 1979 the ten units in service produced 33.3 TWh, or 32.3 percent of the electrical energy supplied by Ontario Hydro. The Bruce A heavy water plant was in service, Bruce HWP B under construction, and Bruce HWP D mothballed; all the heavy water plants have a nominal capacity of 105.6 kg D_2O/h. Operating experience at each of the power plants and heavy water plants is given, and design and development programs including the Pickering tritium removal plant, fuel channel replacement and waste management program are discussed.

1940 Measurement and prediction of vibration in CANDU-PHW fuel and channel assemblies. Lane, A.D.; Oldaker, I.E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment); Forrest, C.F.; Stern, F. (Westinghouse Canada Ltd., Hamilton, Ontario); Orpen, V.C. (Atomic Energy of Canada Ltd., Ottawa, Ontario). pp 1-11 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

CANDU-PHW reactors have horizontal pressure tubes, each containing up to 13, separate, 0.5 m long fuel bundles. This orientation, coupled with the use of short, individual fuel bundles, results in more important differences in vibration behaviour than is the case for other types of pressure tube reactors, all of which are vertical. Continuing evolution of this reactor type has necessitated a fundamentally based vibration testing program in addition to conventional prototype endurance tests. This program includes development and use of techniques for sensing vibration, monitoring the parameters which affect vibration in all tests, specific mechanistic tests to relate vibration behaviour to design features and environmental conditions, simple visual tests to optimize designs, and the generation of analytical models to focus development effort and serve as an aid to design.

1941 Solid-fluid interactions in the vibration of nuclear fuel bundles. Jagannath, D.V. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment); Paidoussis, M.P. (McGill Univ., Montreal, Quebec (Canada)). pp 13-26 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

A method is presented for the calculation of the eigenfrequencies of a cluster of parallel, flexible cylinders, resting in a rigid, horizontal, liquid-filled cylindrical channel, which typifies a CANDU-PHWR fuel bundle/pressure-tube arrangement. The method accounts for structural as well as hydrodynamic (inviscid and viscous) coupling of cylinders by allowing for arbitrary motion of all cylinders in the cluster. The eigenvalues and eigenvectors are calculated for clusters in vacuum and in still fluid, showing the effects of coupling, as well as the effect of proximity of the cylinders to one another and of confinement, on the vibration characteristics. Some of the structurally coupled modes are radically altered by inviscid hydrodynamic coupling, in still fluid, and a new set of structure-fluid-coupled modes emerges. The effect of viscous coupling is also briefly discussed.

1942 Dynamics of nuclear fuel assemblies in vertical flow channels: computer modelling and associated studies. Mason, V.A.; Pettigrew, M.J.; Lelli, G.; Kates, L.; Reimer, E. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). pp 47-69 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

A computer model, designed to predict the dynamic behaviour of nuclear fuel assemblies in axial flow, is described. The numerical methods used to construct and solve the matrix equations of motion in the model are discussed together with the mathematics developed for forced response calculations. Certain structural and hydrodynamic modelling parameters must be determined by experiment. These parameters are identified and the methods used for their evaluation are briefly described. Examples of typical applications of the dynamic model are presented throughout.

1943 Fuel string dynamics and pressure tube fretting corrosion in the CIRENE power channel. Espinosa, P.D.; Lelli, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)); Possa, G.; Vanoli, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). pp 71-99 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The paper is aimed to give an overall view of the efforts which are being pursued on the problem of fuel string dynamics and pressure tube fretting corrosion in the CIRENE reactor power channel. The experimental and theoretical studies carried out cover the following areas: mechanical characterization of the fuel bundle and of the fuel string in static and dynamic conditions; basic fretting corrosion mechanism between Zr-2 and Zr-2; fuel string vibrations induced by the two phase flow; and full scale endurance tests of the CIRENE power channel in adiabatic conditions. The RandD activities carried out in these areas are briefly presented and the main results up to now obtained are given. The points of major concern are discussed and the program of future investigations is outlined.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 2054, 2059, 2063

1944 Critical heat flux experiments and correlation in a long, sodium-heated tube. France, D.M.; Carlson, R.D.; Chiang, T.; Minkowycz, W.J. (Argonne National Laboratory, Argonne, III.). *Journal of Heat Transfer;* **103**: No. 1, 74-80(Feb 1981).

Critical heat flux (CHF) experiments were performed in the Steam Generator Test Facility (SGTF) at Argonne National Laboratory for application to liquid metal fast breeder reactor steam generators. The test section consisted of a single, straight, vertical, fullscale LMFBR steam generator tube with force-circulated water boiling upwards inside the tube heated by sodium flowing countercurrent in a surrounding annulus. The test section tube parameters were as follows: 10.1 mm i.d., 15.9 mm o.d., material = 2 1/4 Cr-1 Mo of 7.0 to steel, and 13.1 m heated length. Experiments were performed in the water pressure range of 7.0 to 15.3 MPa and the water mass flux range of 720 to 3200 kg/m^{2}xs. The data exhibited two trends: heat flux independent and heat flux dependent. Empirical correlation equations were developed from over 400 CHF tests performed in the SGTF. The data and correlation equations were compared to the results of other CHF investigations.

1945 Application of multivariable frequency response methods to better control system design. Hughes, F.M. (Manchester Univ. (UK). Inst. of Science and Technology); Collins, G.B. (UKAEA Atomic Energy Establishment, Winfrith). pp 289-297 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

The feedwater regulation problem is most severe in fast response nuclear boilers such as the sodium cooled fast breeder reactor. Multi-variable frequency response analysis and design methods have been used to redesign the boiler control system for the UK Prototype Fast Reactor. The investigation involved the derivation of a transfer function model of the plant representing its behaviour near full power, and the application of the Nyquist array and characteristic locus methods to the resulting model. An improved control topology is derived which not only offers less interaction between steam pressure, drum water level and feed pump systems, but also provides improved control of water level in the boiler steam drums.

1946 **Transient calculations of a 45 MW(th) steam generator model for sodium-cooled fast breeder reactors.** Chelli, L.; Papa, G.; Salgo, C. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy)). pp 29-34 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

The fabrication of a 45 MW/sub th/ steam generator model is currently under way on CNEN's sponsorship. The steam generator model will be tested beginning from 1979 on Les Renardieres Sodium Components Test Facility (CGVS), owned by EDF, in the framework of CNEN-CEA R and D agreement for fast breeder reactor development. The test program involves: performance at rated and full power; operational transients; accident simulation; and static and dynamic stability. The test program is intended to assess the performance and structural integrity of the steam generator and to validate the computational techniques developed. After a brief description of the computing codes, the calculated curves will be presented for two of the most relevant accidents (sodium flow stop and steam generator blow-down).

1947 **Verification of a dynamics model of a sodium heated steam generator.** Izume, A.; Kubota, J. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). pp 61-68 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Verification of a dynamics model was made for a 1 MW small sodium heated steam generator in which detail temperature distributions have been measured. This steam generator consists of three helically coiled tubes, each of which being divided into 9 to 12 nodes to facilitate precise measurement of temperature distributions in sodium and water flow, respectively. Eleven dynamic experiments have been conducted by applying step-wise changes in sodium and feed water flow rates, sodium pump trip, feed water pump trip, etc. To verify the dynamics model, the experimental data of the steam generator recorded in magnetic tapes were used directly as the boundary conditions of dynamics model and the calculated temperatures at each node were compared with the corresponding temperatures measured in the steam generator. From this study, it has been proved that this dynamics model presents with high precision the internal water side phenomena, i.e., local inverse responses or different time constant causing water flashing.

1948 **Numerical simulation in unsteady-state running of the 45MW scale model SUPER-PHENIX steam generator.** Lecoeuvre, J.M.; Hemmerich, P. (Electricite de France, 75 - Paris); Fabregue, J.P. (Societe Creusot-Loire, 75 - Paris (France)); Lauret, P. (Novatome Industries, 92 - Le Plessis-Robinson (France)). pp 87-94 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

A 45 MW mock-up of SUPER-PHENIX steam generator was tested on the high power sodium-heated steam generator test loop (the CGVS). Running of the tests and analysis of the results were performed by the various parties interested in the development and construction of such units in France, viz. CEA, CREUSOT-LOIRE, EDF, and NOVATOME. Digital simulation of the mock-up dynamic behavior in the course of a number of operational tests under wide amplitude transient conditions was performed with a non-linear program, i.e., the SICLE code. After a brief description of the mock-up and of the tests, an introduction is made of the computing code, followed by comments on the comparison between test and computation results. This comparison shows that digital simulation of the steam generator operation under transient conditions is very satisfactory: the maximum difference between the reckoned and the measured temperatures is 10°C.

1949 **Experimental tests on buckling of ellipsoidal vessel heads subjected to internal pressure.** Roche, R.L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). pp 159-165 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

This paper presents the tests of a series of eighteen ellipsoidal heads of pressure vessels. These heads were welded to cylindrical shells approximately 500 mm in diameter. They were fabricated in the three following materials: carbon steel in the form of 'XE' thin sheets meeting French standard A36-401 dated February 1969; austenitic steel in the form of thin sheets of grade Z6 CN18-09 meeting French standard A35-573 dated October 1975 (this grade is comparable to ANSI grade 304); and aluminium-magnesium alloy of grade AG3 meeting French standard A507602 (Magnesium content 3 per cent). These tests were part of a test series for the development of elasto-plastic buckling analytical methods. These methods are employed for analysing the mechanical structures of Liquid Metal Fast Breeder Reactors built and designed in France. The results of these tests are also used to validate the 'buckling' modules of the CEASEMT computation system (finite elements) developed at Saclay.

1950 **Comparison of spatial calculation methods for fast reactors.** Nisan, S.; Hammer, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides); Lautard, J.J. (CEA, Centre d'Etudes Nucleaires de Saclay, Dept. des Reacteurs a Eau, Gif-sur-Yvette, France); Mus, M. (Compagnie Internationale de Service en Informatique (CISI), Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance, France). pp 371-381 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In French)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The two- and three-dimensional neutron calculation codes for fast reactors which have been developed at the CEA and are based on the finite difference method are compared with each other and with other CEA codes using the finite element method and the synthesis method (KAPLAN). The whole set is also compared with the CITATION code (Argonne National Laboratory). This comparison demonstrates the advantages of the finite element method for spatial calculations of core configurations associated with critical experiments (rectangular geometry) and configurations representative of power stations, both from the aspect of the time and cost of the calculation and from the aspect of the accuracy of the results obtained (discrepancies in the eigenvalues and from power distributions differing by less than 1% from those obtained by the finite difference method). Thus, for example, the computing time for the ELECTRE finite element code (XY geometry) is a factor of three less than that required for the DIANE code, the CEA's most highly optimized finite difference code. Likewise, the computing time for the DESMEE code, used for hexagonal lattices, is 12 times less than that required for the DF2S finite difference code.

1951 **Application of a new coarse-mesh computational method to the determination power distributions in a heterogeneous-core large fast reactor.** Dorning, J.J.; Lawrence, R.D.; Ougouag, A.M. (Illinois Univ., Urbana (USA). Dept. of Nuclear Engineering). pp 383-399 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

A new highly accurate and highly efficient nodal coarse-mesh diffusion-theory computational method has been applied to the determination of power distributions in a radially heterogeneous 1000-MW(e) LMFBR in order to establish the feasibility of utilizing such modern nodal methods for fast reactor physics, design and safety studies. The two-dimensional and one-dimensional calculations done, using the nodal Green's function method, are described and the results for ksub(eff) and the associated power distributions are presented in detail. One-dimensional calculations for the same

heterogeneous-core LMFBR design done, using our recently developed coarse-mesh discrete nodal Green's function transport theory method, are also described and the results for ksub(eff) and the power distributions are presented. The general high accuracy and high computational efficiency of these new numerical methods result from the coarseness of the meshes combined with (and permitted by) the use of local analytical solutions (Green's functions) within the computational elements used in their formulations. Moreover, the extremely accurate results for power distributions are further enhanced by an additional detail of the formulation, viz. the approximate solution within each computational element is formally developed using a variational principle which has as a by-product the very desirable property of minimizing the error in the calculated local power.

1952 **Critical experiments in a zero-power fast-reactor lattice with breeder zones of thorium and uranium.** Schmocker, U.; Chawla, H.; Gmuer, K.; Jermann, M.; McCombie, C.; Richmond, R.; Seth, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)); Bartine, D.; Ingersoll, D.; White, J.R. (Oak Ridge National Lab., TN (USA)). pp 455-467 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Increased interest in alternate fuel cycles and in non-conventional fast-reactor core designs has emphasized the need for reliable benchmark experiments against which the relevant nuclear data and methods can be checked. In the PROTEUS critical assembly we have recently completed an extensive series of measurements of GCFR lattices which internal and axial blankets of UO_2, ThO_2 and Th metal. The GCFR lattice consists of a PuO_2/UO_2 pin-fuelled zone in a thermally driven assembly. Central values and spatial distributions have been monitored for nuclide reaction rates including fission in ^{239}Pu, ^{233}U, ^{235}U and ^{232}Th, capture in ^{238}U and ^{232}Th and (n,2n) in ^{233}Th. In addition, differential spectrum measurements using proton-recoil counters were performed. The results of the experiments have been compared with calculations based on the UK FGL5 nuclear data library (in which thorium cross-sections are derived from ENDF/B-4 values). Further analyses are in progress. Conclusions to data are that uranium blankets are significantly better calculated by our data and methods than are thorium blankets. The discrepancies between calculation and experiment in thorium systems are, however, not of a magnitude which casts major doubts upon current survey calculations for reactor systems with heterogeneous cores.

1953 **Experimental study of the heterogeneous LMFBR core using FCA assemblies with axial internal blanket.** Nakano, M.; Iijima, S.; Shirakata, K.; Hirota, J. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 3-16 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

To investigate physics properties of the heterogeneous LMFBR core and to examine the reliability of the current data and method for heterogeneous core configuration, an experimental study has been made on FCA VII-3 assemblies which have an internal blanket (IB) at midplane of the cylindrical core. Systematic experiments were carried out on the heterogeneous cores whose IBs were different in composition and thickness. A homogeneous core was also built to compare the results with those obtained on the heterogeneous cores. The sodium-void worth is not sensitive to the composition of IB. The positive void worth in the core of the 40 cm IB is lowered by about 40% compared with that in the homogeneous core. The analysis was made using the JAERI-Fast Set Version II and the diffusion code CITATION. Directional diffusion coefficients were used to take account of the axial streaming. To evaluate transport effects, the S_4 calculation was made. Comparison between the calculated and experimental results reveals the following: ksub(eff) and Pu worth in the core are not well predicted for the heterogeneous core, although they are represented satisfactorily for the homogeneous core. Reaction rates sensitive to the low-energy neutron are underestimated in the IB when they are normalized in the core. Sodium-void worths are fairly well predicted. However, the positive void worth in the heterogeneous core is underestimated, while that in the homogeneous core is overestimated.

1954 **Study of the sodium-void effect in media representative of conventional or heterogeneous fast reactor power plants. Experiments performed under the Pre-Racine programme on Masurca.** Lyon, F.; Rimpault, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides); Martini, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). pp 71-89 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In French)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

To determine the correction factors to be applied to calculations of sodium void reactivity effects carried out in connection with a fast reactor project, the approach taken by the CEA consists in: (a) analysing the measurements made on a reference configuration, i.e. a clean core with a low (8%) concentration of ^{240}Pu; (b) analysing the differences with respect to this reference which are associated with a change in the concentration of ^{240}Pu (18% instead of 8%); and (c) analysing and interpreting experiments performed on a configuration derived from the reference configuration but having an internal fertile zone. The measurements performed involved the fissile and the fertile zones. The procedure foreseen consists, initially, in determining the discrepancies between calculation and experiment due to the calculation methods now available and, subsequently, in deciding on the correction factors to be applied to the central and leakage terms in order to reduce these differences to a minimum. It is intended to apply these transposed correction factors to calculations of the sodium void reactivity effect for power reactors.

1955 **Main characteristics of the Racine programme developed by DEBENE, CNEN and CEA on Masurca for the heterogeneous core concept studies.** Bouget, Y.H.; Hammer, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides); Conversano, R.; Martinelli, R. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari); Helm, F.; Scholtyssek, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). pp 91-100 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

This paper aims to present the main characteristics of the Racine experimental programme which is mainly devoted to heterogeneous core concept studies. The experiment will be performed at Cadarache on the Masurca critical facility within the framework of CNEN-DEBENE-CEA co-operation and will include three major parts: (i) Analysis of a heterogeneous configuration including one central fertile zone and one ring. The results will be compared to the previous ones obtained either for a clean core or for a core including a single central fertile zone; (ii) Parametric studies of design parameters, namely the radial power form factor and the sodium-void effect, as a function of the fertile zone characteristics (volumetric percentage and location). Such experiments aim at improving the optimization studies which are at present in progress for heterogeneous core designs; and (iii) studies of parameters directly related to design such as control problems, interaction effects, and power distribution perturbations.

1956 **Design aspects and problems of heterogeneous cores for SNR 2.** Wehmann, U.; Spenke, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)); Pilate, S. (Societe Belge pour l'Industrie Nucleaire, Brussels). pp 103-114 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Heterogeneous cores of LMFBRs show considerable flexibility in adapting to specific requirements with respect to breeding performance, doubling time, irradiation damage, safety-related reactivity coefficients and power distribution with a single fuel enrichment. In this paper, the nuclear evaluation of the so-called combined design for a heterogeneous core of a large demonstration

breeder reactor is described and compared with an equivalent homogeneous core. The improvement with respect to breeding ratio, power form factor and sodium-void effect is shown. The results of some special investigations on the combined design are presented. It is demonstrated that the decoupling effects are similar to those of a homogeneous core. Transport effects on power distribution and sodium-void effect and condensation effects with different few-group schemes on the power distribution are described.

1957 **Core concepts for fast power reactors. Optimization of the physical characteristics of the BN-1600 reactor.** Troyanov, M.F.; Matveev, V.I.; Novozhilov, A.I.; Bobrov, S.B.; Ivanov, A.P.; Pshakin, G.M.; Proshkin, A.A.; Shafrygin, B.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheski Inst.). pp 117-133 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In Russian)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The paper describes a general approach to the choice and optimization of physical parameters for BN-type fast power reactors. The reactor design features which are important for breeding are considered. Breeding characteristics are evaluated for oxide breeders with consideration of a number of improvements in design and technology permitting an appreciable reduction of doubling time. The possibility of obtaining short doubling times with carbide fuel is evaluated. The results of theoretical studies on a large fast power reactor with a heterogeneous core are reported. It is shown that if metallic uranium is used in the inner blankets it is possible to attain breeding characteristics close to those of carbide-fuel reactors. The safety characteristics of such a reactor are considered. In conclusion, the main considerations underlying the choice and optimization of physical parameters for the BN-1600 reactor are given, together with the calculation results.

1958 **Breeding characteristics of fast reactors with combined oxide and metallic fuels.** Ilyunin, V.G.; Murogov, V.M.; Rudneva, V.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheski Inst.). pp 167-178 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In Russian)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

A study of the characteristics of fast power reactors using combined oxide and metal fuels is reported. Two core fuel arrangements are considered. In the first, oxide fuel assemblies and metallic fuel assemblies are located in the core in some particular optimum proportion, i.e. one possible version of the traditional heterogeneous concept with some initial enrichment of the metallic uranium fuel is considered. In this arrangement, the "metallic" assemblies have to satisfy requirements in respect of maximum burnup (<=1.5% FIMA), initial enrichment (0-2%) and linear load (qsub(e)<=300 W/cm). In the other variant, the metallic and oxide fuels are placed in individual assemblies which make up the core. In this arrangement the fuel elements containing metallic fuel are located only on the side where the "cold" coolant enters the core whereas the oxide fuel is located in separate elements or in common elements with metallic fuel on the side where the "hot" coolant leaves the reactor. The relatively low coolant temperature (tsub(coolant)<=460°C) in the region where the metallic fuel is located ensures a sufficiently high linear load (qsub(e) approximately 500 W/cm) with moderate temperatures at the metallic fuel centre (tsup(max)sub(centre)<=650°C) and in the cladding (tsup(max)sub(clad)<=550°C). It is shown that fast reactors using oxide and metallic fuels in combination have substantially higher breeding ratio and greater specific accumulation of new fuel. The higher internal breeding ratio of the core helps to stabilize reactivity during runs between fuel loadings and the sodium-void coefficient is also improved.

1959 **Physics aspects of a demonstration fast-breeder reactor.** Otake, I.; Inoue, T.; Kawashima, K.; Tomabechi, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). pp 179-190 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

This paper describes the physics problems associated with the demonstration fast-breeder reactor, whose design started in 1975 under the direction of PNC (Power Reactor and Nuclear Fuel Development Corporation). The design electrical output of the reactor has been selected tentatively as 1000 MW(e) with a thermal power of 2500 MW. The reactor core was designed for improved characteristics, mostly based on the technology used for the design of the prototype fast-breeder reactor MONJU. A wide range of design was used to clarify the relations between several important core characteristics and various design parameters. The physics problems discussed in the paper can be classified into the following areas: Statics, including optimization of doubling time, breeding ratio, specification of loadings and power distributions; selection of the control-rod patterns and the control strategy to minimize local power peaking and to maintain power flattening; and sensitivity study of disassembly energy as a function of sodium-void reactivity. Core characteristics such as breeding gain, doubling time, burnup reactivity loss and power profiles, are greatly improved. The results reported in the paper are being used in subsequent design work.

1960 **Studies on heterogeneous core designs for 1000-MW(e) LMFBRs.** Sehgal, B.R.; Fuller, E.L.; Naser, J.A.; Lin, C. (Electric Power Research Inst., Palo Alto, CA (USA)). pp 191-205 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The results of a series of studies on heterogeneous core designs for a large LMFBR are described. These studies, started in 1975, had the objective of designing a low-energetics core with good performance capability. This translated into design of a core with low positive Na void coefficient and a high breeding ratio. Various concepts were studied. These included the axially-heterogeneous, the radially-heterogeneous and the seed-blanket-type core designs. It was concluded that a radially-heterogeneous core design could be optimized to provide a Na void $\Delta k/k$ of less than 2.5$ and core doubling time of approximately 15 years.

1961 **Optimization of fast power reactor cores of the radial heterogeneous type. Parametric studies.** Cabrillat, J.C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). pp 207-232 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In French)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The first comparisons made between the concept of a homogeneous core with two enrichment zones and the concept of a heterogeneous core showed, for the latter solution, shorter doubling times and a rate of introduction which would be more favourable for fast reactors in the long term; on the other hand, the initial investment in plutonium is higher. In an effort to reduce or even eliminate this penalty, systematic studies using the quantity and distribution of internal fertile blankets as parameters were carried out; from these the variations in the main characteristics of heterogeneous cores optimized for power flattening as a function of the proportion of internal fertile blankets were determined. Two types of heterogeneity come under consideration: (a) axial heterogeneity in the form of a single centred plate, and (b) radial heterogeneity in the form of fertile assemblies. It is shown that the amount of plutonium in the heterogeneous core cycle presents a minimum whose value is identical with that of homogeneous cores of the same power and the same fuel pellet diameter given low heterogeneity X (X=internal fertile volume/fissile volume): (a) for a fertile plate, $0<X<10\%$, in which case the heterogeneous solution is scarcely of any interest in view of the complications which are introduced; (b) for fertile assemblies, $8\%<X<20\%$, in which case there is a decrease in doubling time by four years in comparison with the homogeneous core; this more attractive solution has the added advantage of being more compatible with the homogeneous solution (given the same power and same pellet diameter) as far as the pressure vessel and the number of control rods are concerned.

1962 **Neutron studies on 1500-MW(e) cores. Significance of the economic and energy context.** Jegu, J.; Girard, C.; Raballand, J.; Sztark, H. (Novatome Industries, 92 - Le Plessis-Robinson (France)); Bruna, G.B. (Nucleare Italiana Reattori Avanzati SpA (NIRA), Genoa (Italy)); Moreau, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)); Obin, N. (Electricite de France, 75 - Paris); Vergnes, J. (Electricite de France, 75 - Paris. Direction des Etudes et Recherches). pp 233-244 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In French)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Optimization of fast reactor core performance is linked with the determination of an overall strategy for the introduction of fast reactors and with a number of different constraints which inevitably affect the project. These constraints differ from one context to another; they depend for example, on the technological level of the country, its fissionable material reserves and its energy policy. As part of the conceptual design studies for Super-Phenix 2, the authors considered a number of standard situations characterized by various assumptions as to availability of plutonium, difficulties of fabrication and reprocessing, and costs of core and reactor vessel components. For each situation considered they studied a core type which could meet the requirements, with due allowance for known technological limits and possible strategies for the introduction of fast reactors. However, this work does not constitute an economic optimization study; rather, it is simply a neutronics study on the dimensioning of a core, some of whose main characteristics are imposed by external constraints. Various types of cores were studied; these are compared in the context of a conceptual design study, i.e. at a stage in which the choices are still relatively open. This study demonstrates clearly that an optimization in the absolute sense is not possible; different choices have to be proposed for each situation.

1963 **Study of large heterogeneous reactors.** Tsutsumi, K.; Ueda, Y. (Hitachi Ltd., Ibaraki (Japan). Hitachi Works); Otake, I. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). pp 247-263 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Heterogeneous reactors were studied to learn the reactor characteristics for a 1000-MW(e) fast breeder reactor; and the core configuration was optimized to improve the reactor characteristics, especially the breeding performance. The optimized heterogeneous core has the internal blanket of one fourth of the total (core and internal blanket) volume, and has an island internal blanket. The heterogeneous core has a significantly smaller power peaking factor than a homogeneous core and reduces the compound inventory doubling time by 12 years when it has the same fuel pins of 6.5 mm dia. and the same peak linear power. The advantageous characteristics of smaller sodium-void reactivity and smaller neutron flux level were confirmed. The smaller control-rod reactivity worth of the heterogeneous reactor can be compensated for by the smaller burnup reactivity and the increase of the control-rod worth by the ^{10}B enrichment increase and the control-rod pattern optimization. The several per cent larger coolant flow-rate is necessary because of the larger power swing of the internal blanket during the fuel cycles. The largest interaction load due to fuel bowing in the heterogeneous core during the operation is applied on the outer zone since the homogeneous core has the same characteristic. Breeding performance was investigated as a function of the fuel pin diameter, which minimizes doubling time, and is about 8 mm for both the homogeneous and the heterogeneous reactors.

1964 **Use in fast reactors of plutonium recycled in light-water reactors.** Gambier, G.; Gomit, J.M.; Perrutel, J.P. (Electricite de France, 92 - Clamart. Direction des Etudes et Recherches). pp 265-285 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In French)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The plutonium put into fast breeder reactors can have different isotopic compositions, depending on its origin. As the neutron parameters of reactor cores (evolution of reactivity, breeding gains, power distributions etc.) are a function of isotopic composition, an analysis is made of the differences in these parameters according to whether the plutonium comes from a light-water reactor without plutonium recycling or a light-water reactor with plutonium recycling. The study is limited to the first fuel loading and is performed for two 1500-MW(e) fast reactors, one with a homogeneous and the other with a heterogeneous core structure. The differences in the core parameters as a function of the composition of the plutonium are calculated by a direct method and by a perturbation method, and a comparative analysis is made of the results obtained in each case.

1965 **In-pile fuel cycle of heterogeneous oxide fast reactors.** Kuyal, J.; Kuyal, B. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Matveev, V.I.; Novozhilov, A.I.; Bobrov, S.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheski Inst.). pp 287-300 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In Russian)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The paper discusses the main methodological principles underlying the SORYR system of computer programs. This system, which includes the 26-group BNAB data library, can be used for calculations on a fast power reactor during operation, with allowance for refuelling and burnup. A traditional reactor with oxide fuel and sodium cooling was chosen as the basic model for comparison. The transition to a heterogeneous core is made on the assumption that the main engineering and heat-physics characteristics of the reactor are maintained. Neutronics calculations for the internal fuel cycle of heterogeneous reactors are also presented and compared with a traditional reactor, and the effect of the radial and axial blanket configurations on the main system characteristics and their variation between refuellings is studied. Calculations are presented which show the change in breeding characteristics with an increase in the number of fertile bundles in the core for the case of two different compositions of fuel and fertile bundles and for different degrees of plutonium build-up in the fertile bundle. The results of optimization studies on a "salt-and-pepper" core are presented.

1966 **Combined use of uranium and plutonium in fast reactors of high unit power.** Orlov, V.V.; Slesarev, I.S.; Zaritski, S.M.; Zverkov, Yu.A.; Subbotin, S.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii); Sharov, E.N. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). pp 301-313 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In Russian)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The paper considers the possibility of improving the fuel balance of fast reactors during the initial period of development when the growth of their power ratings has to proceed at an especially fast rate - faster than that encountered in nuclear power development as a whole. It is considered that an effective means of reducing the doubling time of plutonium is the use of slightly enriched uranium in combination with plutonium (combined fuel) in a single reactor (breeder-converter). The authors analyse the changes brought about in the basic economic and neutron physics characteristics (and also in the safety features) of reactors operating on dioxide and monocarbide fuels when slightly enriched uranium is included in the composition of the fuel. They also consider problems of providing additional stabilization of the energy release field through non-uniform distribution of uranium. It is established that the inclusion of slightly enriched uranium in the composition of the fuel leads to changes in reactivity compensator volume requirements. It is shown that the use of combined fuel substantially increases the rate of plutonium build-up and improves the neutron properties of the reactor without impairing its economic characteristics.

1967 **Factors governing the choice of geometric configurations for high-power fast reactor cores.** Sztark, H.; Girard, C.; Herault, A.; Raballand, J. (Novatome Industries, 92 - Le Plessis-Robinson (France)); Bruna, G.B. (Nucleare Italiana Reattori Avanzati SpA (NIRA), Genoa (Italy)); Peytier, S. (Electricite de France, 75 - Paris). pp 315-325 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In French)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

In the conceptual design stage preceding the selection of a high-power fast reactor core configuration, an important matter for consideration is the geometrical positioning of the assemblies, once the overall core characteristics have been chosen. Because of their considerable radial dimensions, large cores present a problem on controlling power distribution as the campaign proceeds. In addition to the question of flattening at any given moment, there are thermohydraulic problems, such as thermal penalties due to excessive cooling of certain assemblies. These different considerations will serve as guides both in the choice of a geometric configuration for the core (i.e. the distribution of various types of assemblies) and in the search for a control strategy which is sufficiently well adapted. The paper is based on simple calculations in one radial dimension and suggests that calculations in two or three dimensions should be considered for purposes of confirmation. Subject to this reservation, it concludes that, for the heterogeneous core under consideration, it has been possible to reduce the thermal penalty to its physically inevitable component associated with the loading of fertile assemblies containing plutonium. The situation is less clear in the case of the homogeneous core which is used for comparison, but the thermal penalty there is in any event more limited.

1968 **Recent studies for CDFR.** Brindley, K.W. (Nuclear Power Co. (Risley) Ltd. (UK)); Burstall, R.F.; King, D.C.; Perks, M.A. (UKAEA Risley Nuclear Power Development Establishment). pp 327-344 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The paper presents recent work on a variety of topics concerned with the design of CDFR in the United Kingdom. The work falls into two categories, the first relates to the physics implications of attempts to reduce fuel cost, and the second to overcoming various design problems. In the first category use of axial variations in fuel enrichment and re-use of first charge fuel of low irradiation are discussed in some detail. In the second category are examinations of the movement of a limited number of control rods during operation to mitigate the effects of core support failure, of reduction of outlet temperature variations to relieve thermal fatigue in the above core structure, and of the reactivity effects of thermal bowing in a restrained core.

1969 **Design and nuclear analysis of large homogeneous and heterogeneous LMFBR cores using multi-dimensional diffusion codes.** Mockel, A.; de Wouters, R.; Pilate, S. (Societe Belge pour l'Industrie Nucleaire, Brussels); Buckel, G.; Kiefhaber, E.; Polch, A.; Thiem, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)); Wehmann, U. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). pp 349-370 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

In a joint effort Belgonuclaire (BN), Interatom (IA) and Kernforschungszentrum Karlsruhe (KfK) have designed and are still studying a homogeneous and a heterogeneous version of the core of a 1300 MW(e) LMFBR. The main computer program used to calculate the burn-up history of the reactor is KASY, a synthesis code developed at KfK. The synthesis approximation allows the complex 3D triangular-Z geometry of the reactor to be presented accurately with small computing times. This paper is mainly devoted to the calibration of the synthesis technique with respect to a reference solution obtained by a 3D finite-difference program. Results using two to four trial functions show that usually the simplest synthesis (two trial functions, fixed buckling) is already satisfactory for the main core parameters, including ksub(eff), control-rod worths, internal breeding properties and the distribution of power density and sodium-void reactivity. The use of a third trial function, representative of the axial blanket, is useful to improve (if necessary) the knowledge of the axial blanket properties. Ways to generate this third function at little expense are discussed. A secondary aspect treated in this paper is the adequacy of the reactivity coefficients (RCs) which have so far been determined using a two-dimensional RZ model. It has been checked that, if the radial dimensions of the model are adjusted to reproduce correctly the radial power distribution, the map of the sodium-void reactivity, which plays a central role in the course of the hypothetical accident, is also in acceptable agreement with the more detailed 3D hexagonal-Z results.

1970 **Breeding performance of metallic Pu-Th, ^{233}U-Th, ^{233}U-^{238}U versus (Pu-U)O_2 fuels in LMFBRs.** Karam, R.A.; Lee, C.C. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). pp 423-438 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

It was of interest to compare under optimum conditions the breeding performance of metallic Pu-Th, ^{233}U-Th, and ^{233}U-^{238}U fuels with (Pu-U)O_2 in LMFBRs. There are two possible strategies with thorium-based fuels: (1) the LWR-generated plutonium is used in interim thorium breeders (Pu-Th) to build up ^{233}U inventory for use in ^{233}U-Th breeders, and (2) a combination cycle involving two reactor types, Pu-Th and ^{233}U-^{238}U. These reactors will operate simultaneously; the excess ^{233}U generated in the Pu-Th reactors is used to fuel the ^{233}U-^{238}U reactors and the plutonium generated in the ^{233}U-^{238}U reactors is used to fuel the Pu-Th reactors. The combination cycle has obvious antiproliferation characteristics. The study comprised the following: reactor size was nominally 1000 MW(e) with two homogeneous core regions in all cases; the sodium coolant outlet temperature was varied between 800 and 1000°F; core heights were 40 and 50 inches; pin diameter varied between 0.25 and 0.45 inches; peak linear power rating fixed at 14 kW/ft for oxide and varied between 20-35 kW/ft for metal; coolant pressure drop was less than 200 lbf/in^2, fuel smeared density was 75% for metal and 88% for oxide; bonding agent was sodium for metal and helium for oxide. For a given pin diameter and peak linear power rating, the code, COROPT, was used to design the fuel assembly and determine optimum fuel volume fraction under realistic technology constraints.

1971 **Theoretical possibility of reducing the doubling time in a fast-reactor by using heterogeneous configurations of various types of fuel.** Orlov, V.V.; Slesarev, I.S.; Zaritski, S.M.; Subbotin, S.A.; Alekseev, P.N.; Zverkov, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). pp 469-480 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In Russian)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The authors have derived approximate expressions relating the doubling time of a fast reactor using various types of fuel simultaneously to the doubling time of traditional (homogeneous) reactors in which these types of fuel are used separately. These relationships afford a means of determining the conditions in which the use of various types of fuel can result in an improved doubling time. It was established that the use of heterogeneous compositions formed from assemblies of homogeneous systems gives a notable gain in doubling time over that of any of the original homogeneous systems if the doubling times were similar to each other. This gain is fairly large even in the case of BN reactors with high fuel volume fractions. The size of the gain depends on the degree of "differentiation" in the neutron and thermal properties of the components of the heterogeneous reactor. An optimum proportion has been found for the assemblies taken from the original homogeneous systems, governed primarily by the ratio of fuel densities. Estimates were made of the advantages of metallic oxide compositions over the traditional compositions used in large, fast reactors of the BN type. These estimates indicate that the former can be considered as alternative homogeneous compositions with carbide or nitride fuel as far as breeding characteristics are concerned.

1972 **Possibilities for improving FBR breeding characteristics.** Ilyunin, V.G.; Kagramanyan, V.S.; Murogov, V.M.; Troyanov, M.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheski Inst.); Shmelev, A.N. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). pp 481-489 of Fast reactor physics 1979. Vienna, Austria; IAEA (1980). (In Russian)

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The authors use a simplified analytical model of a developing two-component nuclear power scheme to study the relative economic impact on power production of such factors as the generation of surplus nuclear fuel, load density and power plant efficiency. The relationships which they derive make it possible to compare, by simple modelling of different nuclear power strategies, the roles of different schemes of fast-reactor improvement - for instance increased efficiency and increased production of secondary fuel. A number of examples are given by way of illustration.

1973 **Fast reactor physics 1979. Proceedings of an international symposium jointly organized by the IAEA and the OECD NEA and held in Aix-en-Provence 24-28 September 1979.** Vienna; IAEA (1980). vp. (In French). (IAEA-SM—244/17; CONF-790933—(Vol.2)). NTIS (US Sales Only).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Separate abstracts are presented for each of the conference papers included in the data base.

1974 **Study of an exisymmetric model for the parametric analysis of a 3D complex steel structure.** Morel, A.; Rodet, E. (Societe Nucleaire Europeenne a Neutrons Rapides (NERSA), 69 - Lyon (France); Electricite de France, 69 - Lyon); Besnier, F.; Rozenblum, G. (Compagnie Internationale de Services en Informatique (CISI), 75 - Paris (France)). pp M3/7 (1-9) of Structural mechanics in reactor technology. Transactions. Vol. M. Methods for structural analysis. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The design analysis of the slab (metallic annular plate filled with concrete) of the SUPER-PHENIX Fast Reactor Power Station have shown that the state of deformation was simple although the structure and the state of stress were complex. It then seemed interesting to elaborate an axisymmetric model showing the same response for using with parametric studies.

1975 **Vibrational behaviour of SNR-300 fuel elements: experimental studies in sodium, water and air.** Stehle, H.; Hess, B.; Schmidt, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). pp 115-127 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Experimental investigations of the vibrational behaviour of SNR-300-subassemblies are described in detail. The approach discussed could be considered as a more technological one, which rather relies on experimental proof and ascertainment of numerical predictions during full scale experiments with dummies in water and sodium flow than on sophisticated calculations following complex design guides. Full scale experiments are believed to offer the best out-of-pile simulation of the expected in-service behaviour subassemblies and can, after a long term experiment, demonstrate if vibration enhanced friction wear or fatigue do occur or not. The strong experimental evidence gained throughout the investigations discussed demonstrates clearly that for the SNR-subassemblies, flow induced vibrations are expected to be far below any critical design limit during in-pile service.

1976 **Measurements of the flow-induced vibration of an LMFBR free-standing fuel element in a water loop.** Robinson, R.G.J. (UKAEA Risley Nuclear Power Development Labs.). pp 129-150 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

At Risley Nuclear Power Development Laboratories the prediction of flow-induced vibration amplitudes in LMFBR fuel elements involves determination of the individual behaviour of single fuel elements and also their group interaction. Vibration tests on a single fuel element are described, involving measurements in air and static water, of its natural frequency, stiffness, frequency response function and damping factor; also measurements in full flow of the force excitation and displacement. Good general agreement is obtained with the relevant theoretical values under static fluid conditions and the vibration characteristics are used, together with the exciting force, to predict a value of the flow-induced vibration amplitude which gives a fair correlation with the measured flow-induced amplitude. The spectrum of the flow-induced displacement shows frequency peaks near the calculated values, while the force spectrum is roughly flat over the region of frequencies to which the fuel element responds. In preliminary results from a group of eight fuel elements, the single element natural frequency shows up clearly in the displacement spectrum along with an additional 'group' frequency, while the RMS amplitude of the group is approximately 60% above that of the single fuel element.

1977 **Measurements of sub-assembly vibration during sodium commissioning of the PFR.** Bentley, P.G.; Taylor, A.F.; Thatcher, G. (UKAEA Risley Nuclear Power Development Establishment). pp 151-165 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Results of vibration tests carried out on the centre group of core sub-assemblies in the PFR during sodium commissioning are described. Signals were obtained at 1, 4 and 10Hz approximately with a total RMS amplitude of 0.005 in. This result is compared with measurements on a group of sub-assemblies and carrier in a water loop where a total amplitude of 0.002 in. was measured with dominant frequencies of 3, 5, 7 and 10Hz approximately using similar instrumentation. The 1Hz signal, which is dominant in the reactor has not been satisfactorily explained.

1978 **Measurements of fluctuating forces generated by internal flow in pipe line components.** Spanton, J.H.; Ashton, M.W. (UKAEA Risley Nuclear Power Development Labs.). pp 633-655 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Results are presented of the initial work on three basic axisymmetric test section geometries: a clear straight pipe section; orifice plates mounted in a straight pipe, and abrupt contractions of a pipe bore. The resultant fluctuating forces and couples acting on a test assembly were measured directly by mounting the components on force transducers. A general analysis of the flow-induced and restraining forces acting on a rigid test section mounted in such a manner is presented. Some supporting wall pressure fluctuation data is also included. Force and pressure data are presented as normalised RMS levels and normalised PSD plots against a suitably defined Strouhal number. A broad peak in the PSD distributions is found, at a Strouhal number of about 0.01, which appears to be associated with the region just downstream of a vena contracta. Extrapolation of the data to a typical fast reactor pipework circuit indicates a peak frequency of the order of 1Hz and peak to peak lateral forces of up to 4kN for an 80% blockage ratio.

1979 **Acoustic vibration measurements in PFR.** Bentley, P.G.; Rowley, R. (UKAEA Risley Nuclear Power Development Labs.). pp 833-849 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Acoustic excitation is a principal source of vibration in PFR. Pumps produce acoustic pressures of up to 2.2 psi at twice blade passing frequency which is 224Hz at full speed. This excites structural resonances particularly an upper duct ovalling mode at 170Hz and other modes in the lower ducts and primary tanks. Stresses are small, the broadband level being below 300 psi rms and single frequency components below 100 psi. Loss factors have been measured and range from 0.005 to 0.1 on different components. Asymmetric pump operation produces a random pressure fluctuation attributed to non-return valve flutter when the speeds differ by more than a critical few per cent.

1980 **Acoustic vibration model of a fast reactor.** Firth, D.; Bentley, P.G.; Rowley, R.; Beesley, M.J. (UKAEA Risley Nuclear Power Development Labs.). pp 851-861 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The mathematical scaling laws for designing a model of a sodium-cooled fast reactor to study acoustically induced vibration are derived. The use of these in constructing an actual water model at a scale of .13 is outlined. Results of a preliminary stress survey are given, and estimates for the reactor are derived.

2107 Regulation And Licensing

1981 **Seismological shoot-out at Diablo Canyon.** Smith, R.J. *Science (Washington, D.C.);* **214**: 528-529(30 Oct 1981).

The Pacific Gas and Electric Co.'s right to operate a nuclear power plant at California's Diablo Canyon has been contested for eight years at 36 federal and four state hearings, three licensing appeals, and two congressional inquiries. The utility announced that design errors in the structural supports were discovered just as the plant appeared ready for operation. Corrections will be technically straightforward, but the political and legal ramifications may cause further delays by supporting the claims of environmental groups that the plant cannot withstand an earthquake. A review of the debate indicates that the developing field of seismic engineering is still imprecise because the theoretical bases remain untested. (DCK)

2108 Economics

1982 (INIS-mf—6285, pp 171-182) **Development of capital cost of nuclear power plants.** Supadi, S. (Gama Research Centre, Jogyakarta (Indonesia)). 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Development of capital cost of nuclear power plants containing cost estimation and increasing is presented.

1983 (INIS-mf—6285, pp 193-209) **Cost estimation of nuclear power plants.** Nengah Sudja, D.I. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Estimation of nuclear power plants capital cost is discussed covering the cost difference and definition.

1984 (INIS-mf—6285, pp 221-228) **Estimation of the cost of electric power plants.** Nengah Sudja, D.I. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Cost estimation of nuclear power plants containing annual unit energy generation cost of oil, charcoal and nuclear power plants are presented.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

1985 (EUR—6813(v.1), pp 668-669) **Review of the 'Mathematical Content' of paper for workshop H, adjustment codes, uncertainties, and input needs.** Stallmann, F.W. (Oak Ridge National Lab., TN (USA)). 1980. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

1986 (EUR—6813(v.1), pp 670-673) **Review for workshop on adjustment codes uncertainties and input needs.** Zijp, W.L. (Netherlands Energy Research Foundation ECN, Petten). 1980. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

This review deals with the practical aspects and the user's needs with respect to adjustment procedures. The output spectrum is dependent on the type and quality of input values especially of its covariance. Adjustment codes are given. The trends in the adjustment of neutron spectra are: development and improvement of codes, preparation of covariance matrices, and solution of inconstency problems.

1987 (IA—1356, pp 33) **Spectral fine-structure effects in cross section sensitivity analysis.** Karni, Y.; Grenspan, E. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

1988 (IA—1356, pp 35-36) **Accounting for leakage in discrete-ordinate thermal reactor lattice calculations.** Schneider, A.; Karni, Y.; Greenspan, E. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 1908, 1929, 1931, 1932, 1935, 1949, 1978, 2061, 2062, 2064, 2304, 2357, 2433, 2434

1989 **(EPRI-NP—2024) Static stress-intensity factors and dynamic crack propagation in pipes. Annual report, September 1981.** Emery, A.F.; Kobayashi, A.S.; Love, W.J. (Washington Univ., Seattle (USA). Dept. of Mechanical Engineering). Sep 1981. 206p. NTIS, PC A10/MF A01. Order Number DE82900365.

Predictive models for critical flaw sizes, initiation and propagation of dynamic cracks in pipes, and the behavior of dynamic crack propagation in compact specimens are described. Parametric results are reported that may be used to predict critical flaw sizes for the initiation of a running crack as well as the crack propagation rate under fatigue in precracked pressurized and thermally shocked cylinders and nozzle-cylinder intersections. Fundamental properties governing rapid crack propagation and crack arrest are described, as are studies on the initiation and propagation of circumferential through cracks in pipes subjected to axial tension. Included are discussions of the use of (1) the three-dimensional finite element code, SAP IV, to analyze the dynamic fracture response of preexisting axially oriented through cracks at the centers of a local bulge in a pressurized pipe and (2) the thermal-hydraulic code LEAKER to predict the nondimensionalized depressurization rates measured ynthesized, and seven were tested in the gas phase. In Task 3, the distributor plate foen conversion can be controlled by adjusting external variables of the coss two- fatigue stren obtained.

1990 (EUR—6813(Vol.1), pp 631-634) **ASTM E-10 and C-26 standards.** Lewis, R.H. (Babcock and Wilcox Co., Lynchburg, VA (USA)). 1980. Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Committee E-10 on Nuclear Technology and Applications and Committee C-26 on Nuclear Fuel Cycle are the two major nuclear standards writing committees at ASTM. Traditionally E-10 was concerned with radiation damage to reactor structural materials, nuclear fuel burnup and neutron dosimetry. C-26 was interested primarily in reactor fuel specifications, fuel rod cladding and control materials. In recent years E-10 and C-26 have greatly broadened their scope to cope with the changes in the light water reactor development. Evolution and future of these standards are described.

1991 (IA—1356, pp 270-271) **Reliability of the electrical power supply to a nuclear power plant. A comparative study.** Hertz, Y.; Ilberg, D. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

1992 **Results of the pressure vessel research committee program on reliability of ultrasonics.** Chockie, L.J. (General Electric Co., San Jose, CA (USA)). pp 115-132 of Non-destructive examination in relation to structural integrity. Nichols, R.W. (ed.). London, England; Applied Science (1980).

From 1. international seminar on non-destructive examination in relation to structural integrity; Berlin, Germany, F.R. (1979).

An industry and government cooperative program was organised by the Pressure Vessel Research Committee (PVRC) over 10 years ago to address the question 'how effective are currently used inspection techniques and what new inspection techniques may be applied to weldments and fabrication of vessels fabricated of heavy-section steels'. One of the most significant results obtained so far is the application of the linear elastic fracture mechanics methods as applied to assess the structural integrity of nuclear reactor pressure vessels and the requirement that nondestructive examination methods measure the length, depth and position of flaws in the structure. Ultrasonic examination methods, offering the most promise, have been developed as a result of the PVRC program and are now mandatorily required for nuclear reactor vessels and components. Twelve large test blocks, each containing intentionally placed flaws, were fabricated for the PVRC program; and, as improvements in the reliability of detection and analysis evidenced themselves, some blocks were sectioned to prove the capability or to identify the need for more work. Three blocks were donated to the European PISC Program and a similar arrangement has now been developed for exchange of test blocks with Japan.

1993 **Void-flow instability. Prediction and verification of operating limits.** Vriesema, R. (Tebodin N.V., The Hague (Netherlands)); Latzko, D.G.H. (Technische Hogeschool Delft (Netherlands)). pp 139-150 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Any analysis aimed at verifying that a given steam generator design will behave in a stable manner for all operating conditions foreseen, will have to take account of a system of considerable complexity, i.e., the steam generator proper - consisting of headers, interconnected by parallel channels - as well as the associated feedwater supply and steam utilization subsystems. The mathematical analysis of such a system is best performed in the frequency domain, where the stability criteria for the various possible modes of oscillation may be expressed in the transfer functions of the different subsystems and experimental verification may be obtained by frequency response analysis in a single tube test facility. A model called CURSSE is described.

1994 **Steam generator stability at variable loads.** Andreev, P.A.; Alferov, N.S.; Kudriavtsev, I.S.; Paramonov, P.M.; Pascar, B.L.; Rybin, R.A.; Sudakov, A.V.; Terentiev, I.K.; Fedorovich, E.D. (Polsunov Central Boiler and Turbine Institute, Leningrad (USSR)). pp 185-190 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Experimentally and theoretically the stability of the steam generating bayonet type channels was studied. The boundaries of the stable operating via mass flux and pressure are found. Based on the temperature oscillations in the channel measurements results the intensity and effective oscillations period are calculated statistically as functions of the parameter.

1995 **CROSSMIX: a mathematical model of a multi-pass cross-flow heat exchanger with primary fluid mixing.** Fallows, T.; Gane, C.R.; Jones, R.C.; Lis, J.; Massey, T.H. (Central Electricity Research Labs., Leatherhead (UK)). pp 391-396 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

A two-dimensional model of a multi-pass cross-flow heat exchanger incorporating the interaction between primary and secondary fluids has been developed. Turbulent mixing and the cross flows due to temperature induced density gradients in the primary fluid are also included. The modelling equations are solved numerically using finite difference methods. The model is applicable to either serpentine or helical boilers and enables the effects of blanked-off tubes and other asymmetries to be predicted. An essential input to the model is the turbulent diffusivity within the relevant boiler geometry and the acquisition of these experimental data is discussed.

1996 **Ionic thermometers and their application in the nuclear thermometry.** Strnad, M.; Jakes, D. (Power Research Institute, 468 41 Tanvald, Czechoslovakia). pp 63-72 of Measurement for progress in science and technology. Volume 2. Proceedings of the 8th IMEKO congress of the International Measurement Confederation held in Moscow, USSR, 21-27 May 1979. Solt, J.; Kemeny, T. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From 8. IMEKO congress; Moscow, USSR (21 May 1979).

An original method of temperature measurement based on the steep conductivity change connected generally with phase changes is reviewed. The ionic substances are now applicable in the range from 300 to 650°C. The selection of these compounds is now based on reviewed thermodynamical as well as electrochemical conceptions. The preliminary irradiation tests in experimental nuclear reactor VVRS in Rez as well as running experiments in high flux reactor MARIA in Swierk (Poland) has confirmed the applicability of ionic thermometers in reactor core. The prospect is to apply them, after finishing present stage of reactor tests, for in-core verification of thermocouples long-term accuracy.

1997 **Reliable economic heavy duty pressure components. The next twenty years.** Latzko, D.G.H. (Technische Hogeschool Delft (Netherlands)). pp ix-xxi of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The following aspects of the subject are discussed: markets for pressure vessels; redistribution of industrial activities in the world related to demographic changes; changes in design codes based on analysis rather than on large safety factors; welding methods; detection and analysis of defects; inspection methods; valve design; chemical composition; safety and testing.

1998 **Evaluation of flaw tolerance. Use of a sensitivity analysis on the input data in contrast to rigid safety factors.** Milne, I.; Harrison, R.P.; Dowling, A.R. (Central Electricity Generating Board, London (UK)). pp 25-32 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The acceptability of defects in structures, whether postulated or real, is most commonly judged on the basis of a fixed factor between the defect size and the critical defect size at which failure of the component might be expected to occur. In this paper that approach is shown to be somewhat arbitrary and not necessarily consistent with conventional design factors such as that on maximum stress. A sensitivity analysis, performed by systematically varying input parameters in ways justified by the status of the data, is encouraged by the CEGB defect assessment route. Such a procedure is carried out in this paper on a problem which could occur in a nuclear pressure vessel. It is demonstrated that confidence in the analysis can be increased and the true risks of the final judgement quantified. This type of analysis can be used to justify or discourage more detailed analytical procedures or experimentation, more accurate data collection or modification of plant operating regimes.

1999 **Probabilistic assessment of flaw evaluation procedures for pressure vessel integrity.** Shaffer, D.H. (Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA)); Bamford, W.H.; Jouris, G.M. pp 45-55 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Prudent design procedures, in order to err in the direction of conservative over-strength rather than risky under-strength, have taken bounding values rather than best estimates for material parameters, and wherever possible, used conservative input for the calculations. The growing data base for this work is now beginning to allow an assessment of the conservatism that has been incorporated into the design procedure. Quantitative estimates of the variability associated with crack growth rates and fracture toughness have been generated in connection with other studies, and it would be useful to incorporate such information into an overall assessment of the design margins that are prescribed. In addition to getting an estimate of the conservatism in the current procedure, this study should provide a useful insight into the relative degree of margin that is introduced at each stage of the flaw evaluation process. Identification of the step by step margins should lead to more effective data collection programs from which information for adequately controlling the design conservatism can be obtained. The study will also provide valuable guidance in fixing revised design reference curves and safety factors so that adequate overall margins can be maintained without excess conservatism. This study is limited to vessel rupture in a brittle mode, and examples for illustration are particularly related to the beltline region of a reactor pressure vessel.

2000 **Method for deriving reactor operating limits using probabilistic fracture mechanics.** Botterill, J.A.; Fulford, I. (Rolls-Royce Ltd., Derby (UK)). pp 57-62 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

A light water reactor is controlled so that it remains within permitted zones on a pressure-temperature operating diagram. The line bounding the prohibited area of possible brittle fracture is related to the material nilductility transition temperature which increases during reactor life because of the effect of irradiation. There is an increasing incentive to quantify the implied margins of safety and to establish a rational basis for the brittle fracture boundary. A method is proposed to derive a new brittle fracture boundary, based on fracture mechanics, which relates reactor operation to a defined level of vessel failure probability. The objective of the method is to derive lines of constant failure probability on the pressure-temperature operating diagram. Central to the derivation of the new boundary is the calculation of vessel failure probability which is, in our case, based on statistical distributions of defect depth and fracture toughness. Failure probability is calculated as a function of time during an operating transient, and families of pressure-temperature curves for given values of failure probability constructed for particular times during the vessel life.

2001 **Practical applications of probabilistic structural reliability analyses to primary pressure systems of nuclear power plants.** Witt, F.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). pp 63-70 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Primary pressure systems of nuclear power plants are built to exacting codes and standards with provisions for inservice inspection and repair if necessary. Analyses and experiments have demonstrated by deterministic means that very large margins exist on safety impacting failures under normal operating and upset conditions. Probabilistic structural reliability analyses provide additional support that failures of significance are very, very remote. They may range in degree of sophistication from very simple calculations to very complex computer analyses involving highly developed mathematical techniques. The end result however should be consistent with the desired usage. In this paper a probabilistic structural reliability analysis is performed as a supplement to in-depth deterministic evaluations with the primary objective to demonstrate an acceptably low probability of failure for the conditions considered.

2002 **Prediction of failure of welded steel plates for pressure vessels.** Gulvin, T.F. (British Steel Corp., Motherwell); Terry, P. (UKAEA Risley Nuclear Power Development Establishment); Webster, S.E. (British Steel Corp., Rotherham (UK). Sheffield Lab.). pp 71-84 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The avoidance of brittle fracture in pressure vessels and other welded steel fabrications is a matter of considerable importance. The application of fracture mechanics to this problem has led to the evolution of a philosophy which, among other things, permits estimation of tolerable crack sizes so that practical working limits can be set on inspection procedures and on material and welded joint toughness levels. The use of small-scale fracture mechanics tests, particularly crack opening displacement (COD) tests, to make the necessary material and/or joint property assessments is now commonplace. A number of possible analytical techniques have been considered. Initially, the COD data have been used with the Burdekin-Dawes design curve approach taking into account all the possible stress conditions and, it can be demonstrated, that consistently safe predictions of allowable flaw sizes can be made. Also considered, is the fracture analysis diagram approach of Harrison, Loosemore, and Milne in which a combination of fracture toughness data and mechanical property data is used to assess the probability of failure. Similarly the approach defined by Irvine and Quirk which makes use of mechanical property data without resorting to fracture mechanics and finally, a simple approach using uniaxial tensile property data only has also been examined.

2003 **Break-through and ductile fracture of reactor components with a surface crack. (J-Integral approach to a surface crack).** Kitagawa, H.; Nakagiri, S.; Yuuki, R.; Ogura, K. (Tokyo Univ. (Japan). Inst. of Industrial Science); Kisu, H. (Tokyo Univ. (Japan)). pp 103-110 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

J-integral approach including some experimental work is extended to a surface crack, which seems to be more practical than a through crack in the structural component. Starting from J.D.Eshelby's energy momentum tensor theory, some J integrals for a surface crack are derived, which are independent of three dimensional integral paths over surfaces surrounding the crack, in the same manner as in the two-dimensional problems. An experimental method is proposed to determine the J integral for both a through and a surface crack using a load-displacement curve. Plate specimens with a surface notch and CT specimens of a reactor material were pulled. Jsub(IC) values obtained from both types of specimens agreed well. Therefore it can be considered that the J integral is a useful tool as a fracture criterion of the surface crack.

2004 **Aspects of leak before break quantification in pressurized pipes.** Hellen, R.A.J.; Darlaston, B.J.L.; Connors, D.C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). pp 111-116 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

In fitness for purpose studies of pressurized structures containing defects, the concept of leak before break is often invoked. As the assumptions used in the concept are sometimes very pessimistic it is desirable to be able to quantify them more precisely. Two aspects are currently receiving attention; these are the way in which a crack profile develops during fatigue and what happens when the remaining ligament below the crack fails. These aspects are being evaluated experimentally and theoretically. Data are presented from tests on pipes subjected to cyclic pressure and subsequently failed. An analytical approach is proposed on the question of ligament failure, this being based on the development of some recent work on flat plates. The overall question of leak before break is considered. As the understanding and confidence increases, it is possible to reduce the range of interest and focus on specific aspects of the problem. This paper examines these aspects.

2005 **Some fracture mechanics applications of warm prestressing to pressure vessels.** Chell, G.G. (Central Electricity Research Labs., Leatherhead (UK). Materials Div.). pp 117-124 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Using a theory of warm pre-stressing (WPS) based on the J-integral expressions are derived in the small scale yielding regime which relate the failure lond at the operating temperature to the WPS loading history and the flow stresses at operating and WPS temperatures. The expressions are applicable to extended defects in plane and axisymmetric geometries subjected to arbitrary loading, as well as penny-shaped defects subjected to arbitrary radially symmetric loading. The theory is validated by the successful analysis of experimental WPS data obtained for A533B steel. It is shown that the integrity of a cracked structure after WPS is not defined only by the operating load, but depends strongly on the WPS loading history. To illustrate the beneficial effects which can arise from WPS the theory is applied to the analysis of a cracked pressure vessel subject to thermal transients similar to those which could be experienced during a loss of coolant accident in a pressurized water reactor. It is shown that WPS may inhibit the growth of cracks in the vessel wall even though the thermally induced stress intensities may exceed the fracture toughness of the structural steel.

2006 **Thermal shock fracture of initially cracked hollow cylinder.** Yagawa, G.; Ichimiya, M.; Ando, Y. (Tokyo Univ. (Japan). Faculty of Engineering). pp 125-129 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The present paper deals with the problem of the fracture of pipes subject to thermal shock based on the linear elastic fracture mechanics. Thermal shock experiment with carbon steel pipes is carried out to investigate the fracture behaviour of cracks inside the pipes under thermal transient. The experimental results are compared with the theoretical results based on the linear elastic fracture mechanics. The measured and estimated times of fracture elapsed from the sudden cooling agree within the tolerable accuracy except the cases of comparatively small initial cracks.

2007 **Elastic plastic fracture toughness and the fatigue crack growth resistance in base metals and weldments of A533B-1 and 304 steels.** Kobayashi, H.; Nakamura, H.; Nakazawa, H. (Tokyo Univ. (Japan). Faculty of Engineering). pp 251-256 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

In this work, elastic plastic fracture toughness Jsub(IC) values of base metals and their weldments, pressure vessel steel A533B-1 and piping steel 304, are evaluated according to a proposed test method. Furthermore, fatigue crack growth characteristics of these materials are evaluated. Results are discussed in relation to material properties given in the ASME Boiler and Pressure Vessel Code.

2008 **New process for the relief of mechanically induced stresses in steam generator tubes.** Joyeux, J.P. (Framatome, St. Marcel (France)). pp 83-85 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Heat exchangers include very generally a set of tubes assembled in 'U-type' exchangers or in 'pass-through' exchangers. The tubes are introduced in holes drilled in the tube sheet plate, welded at their extremity and expanded to insure the necessary tightness. The steam generators built by FRAMATOME belong to the U-type and include, depending upon the nominal power of the plant, about three or five thousand inconel tubes. This material has been selected for its resistance to corrosion action at high temperatures. But one drawback of inconel is that residual stress lowers considerably this resistance to corrosion; so it is very important to apply manufacturing processes involving a residual stress level as low as possible. A new process, which involves 'kiss' rolling, is described.

2009 **Analysis and design of large nuclear low pressure turbine outer cylinder.** Aneja, I.K.; Groenendaal, J.C. (Westinghouse Electric Corp., Philadelphia, PA (USA). Steam Turbine Div.). pp 179-184 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

This paper describes the application of the latest advances in analysis and design of current large nuclear low pressure turbine outer casings. It includes a brief description of the finite element models used for static and live load analyses for various load conditions and special analysis for the support foot. Scaled plastic model

tests (static and dynamic) are also discussed for verification of the analytical results.

2010 **Application guide for the time-history plastic analysis of piping systems.** Yeh, G.C.K. (Bechtel Corp., Los Angeles, CA (USA)). pp 229-232 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

In many cases when linear elastic analysis for the response of a piping system to time-dependent forces and displacements fails to satisfy the requirements of Section III of the ASME Boiler and Pressure Vessel Code it is possible to verify the adequacy of the design by using nonlinear plastic analysis. This paper presents a procedure for performing a time-history plastic analysis utilizing general purpose or piping analysis computer programs. It provides novice stress analysts with an informative guide on some specific requirements, applications, notes of warnings and realistic examples for the practical implementation of such an analysis.

2011 **Plastic collapse of a piping elbow. Effects of finite element convergence and residual stresses.** Dhalla, A.K. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). pp 243-249 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Thin piping elbows are among the most highly strained components in a piping system and must be evaluated to assure that deformation limits are satisfied. In addition, failure of a piping network at an elevated temperature due to a buckling of an elbow, or large deformations due to elbow instability, must be evaluated using an appropriate geometrically nonlinear analysis method. At present, neither Section III of the ASME Boiler and Pressure Vessel Code for low temperature design, nor Code Case N-47 for elevated temperature design, provide specific guidance for the calculation of elbow buckling loads. Previous investigators have reported satisfaction of the buckling criteria and the inelastic strain limits of ASME Code Case N-47 using a simplified pipe bend model. However, the simplified analysis neglects the stiffening effect of straight pipes welded to the elbow; and omits certain thin shell deformation modes. The objectives of this paper are: (1) to present an analytical capability to predict collapse of an elbow structure with end pipe stiffening effects, (2) to provide guidance in the selection of element mesh size and load step size for nonlinear finite element shell analysis, and (3) to evaluate the effects of residual stresses due to a thermal transient upon the load carrying capacity of an elbow structure.

2012 **Stress analysis of pressurized elbows for nuclear components using toroidal elasticity.** Lang, H.A. (System Development Corp., Santa Monica, CA (USA)). pp 251-260 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The new and developing theory of toroidal elasticity is applied to the determination of complete stress fields and displacements in elbows of nuclear plant components, such as heat exchangers and steam generators. A programme has been established to further the application of this theory. The first phase of this programme concentrates on ten basic boundary value problems for the 90° elbow. The problem of the 90° elbow under pressure has been selected as the most significant of these problems to report on initially. The second phase of this program depends upon selecting the problems which, collectively, represent the complete solution of the end-loaded 90° elbow. It is then possible to assess the seriousness of the discontinuity stresses in the neighbourhood of the junction between the 90° elbow and any contiguous cylindrical shell to determine whether such stresses might produce vessel failure or vessel strengthening - an important fact when the typical design life is thirty years. The ASME Boiler and Pressure Vessel Code acknowledges the need for additional work in the area of end effects for curved pipe or welding elbows. In the current studies, the cross-section of the toroidal shell is circular and may have any wall thickness. The solution for a solid cross-section is usually obvious from the solution for the hollow section. The limitation to circular cross-sections is probably removable. The input parameters used to generate numerical results correspond very closely to three specific heat exchanger designs and one steam generator design intended for operation in nuclear breeder reactor plants.

2013 **Criterion for analysing fatigue crack initiation in geometrical singularities.** D'Escatha, Y.C. (Service de l'Industrie et des Mines, Bureau de Controle de la Construction Nucleaire, Dijon (France)); Devaux, J.C.; Bernard, J.L.; Pellissier-Tanon, A. pp 211-222 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

A criterion for determining the number of cycles for initiating fatigue cracking and the initial orientation of crack propagation at acute notches and geometrical singularities is introduced theoretically then verified experimentally. The criterion is based on the calculation of the value and orientation of the maximum range $\Delta\sigma$sub(thetatheta)(d) of the normal stress at the distance d of the notch tip. Its application to the analysis of three nozzle thermal sleeves socket weld attachments is presented. The results are used to check simplified methods of analysis based on stress indices or on the use of linear elastic fracture mechanics.

2014 **Ferritic steel plates for pressure vessels. Chapter 1.** Hamilton, I.G. (Babcock and Wilcox Ltd., Renfrew (UK)). pp 1-33 of Developments in pressure vessel technology - 3. Materials and fabrication. Nichols, R.W. (ed.). London, England; Applied Science (1980).

The main developments and problems which have arisen with carbon, micro-alloyed and ferritic alloyed steels used in pressure vessel manufacture are considered. The changes in steelmaking practices have greatly affected the quality of these steels. The work on elevated-temperature strength and low-temperature notch toughness properties of carbon and carbon-manganese steels is briefly described. The evolution of the micro-alloyed steels and the general principles on which they are designed are discussed, along with the difficulties of forming and welding. In the low alloy steel classification two particular examples are singled out, namely the nuclear plate steel A533 Gr. B, Class 1 and 2 1/4% Cr-1% Mo steels used for thick-walled pressure vessels in the petrochemical industry, for consideration of their manufacturing and operating problems. The use of 9% Ni steels for cryogenic purposes is briefly examined. In conclusion an appendix is given to cover the plate validation programme for a critical application.

2015 **Thick-joint welding process. Chapter 5.** Wood, D.; Terry, P.; Dickinson, F.S. (UKAEA Risley Nuclear Power Development Labs.). pp 145-194 of Developments in pressure vessel technology - 3. Materials and fabrication. Nichols, R.W. (ed.). London, England; Applied Science (1980).

This chapter reviews the techniques currently employed in the welding of pressure vessels, ranging from traditional manual metal arc and submerged arc processes to the more recently introduced narrow-gap and high-energy processes, e.g. electron beam and laser. The effect on the properties of the base materials being joined and the relative economics of the various processes is examined, from which guidance on the balance between joint properties and economy can be gained.

2016 **Radiation damage to reactor vessel steels (parent metal and weld) at 500 and 550°F.** Van Asbroeck, Ph.; Gubel, P.; Pelsmaekers, J. (CEN-SCK, Mol (Belgium)). pp 129-149 of Assuring structural integrity of steel reactor pressure vessels. Steele, L.E. (Naval Research Lab., Washington, DC (USA)); Stahlkopf, K.E. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Systems and Materials Dept.) (eds.). London, England; Applied Science (1980).

From 1. international seminar on assuring structural integrity of steel reactor pressure vessels; Berlin, F.R. Germany (20 Aug 1979).

A statistical analysis of 238 data using non-linear optimisation techniques shows that the shift of the transition temperature (given by the Charpy V notch impact test) of type SA 302 and SA 533 steels (parent metal and weld) irradiated at 500 or 550°F depends on the fluence, the copper and phosphorus contents, the irradiation temperature and the grade of steel. This dependence is depicted by an equation which is presented.

2017 **Direct and predictive techniques for determining radiation embrittlement of pressure vessel steels.** Server, W.L.; Wullaert, R.A. (Fracture Control Corp., Goleta, CA (USA)); Ritchie, R.O. (Massachusetts Inst. of Tech., Cambridge (USA)). pp 177-186 of Assuring structural integrity of steel reactor pressure vessels. Steele, L.E. (Naval Research Lab., Washington, DC (USA)); Stahlkopf, K.E. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Systems and Materials Dept.) (eds.). London, England; Applied Science (1980).

From 1. international seminar on assuring structural integrity of steel reactor pressure vessels; Berlin, F.R. Germany (20 Aug 1979).

New techniques are presented for measuring or predicting radiation-induced changes in fracture toughness. A single specimen technique, involving precracking and side grooves, was developed to measure dynamic J-integral initiation values using surveillance-type specimens (Charpy V-notch). Critical stress and critical strain models were used to predict the effect of radiation on lower and upper shelf fracture toughness. Neutron irradiation was assumed to increase yield strength and to decrease work hardening, while leaving the critical fracture stress for cleavage unchanged. Upper shelf predictions of fracture toughness could only be made for unirradiated material due to lack of data on radiation-induced changes in critical strain (ductile fracture).

2018 **Review of research conducted in the USSR on improving the reliability of the machine-foundation-soil system and evolving new structural designs for foundations of large-capacity machine sets.** Skadnev, M.F.; Sheinin, I.S. (Vsesoyuznyj Nauchno-Issledovatel'skij Geologicheskij Inst., Leningrad (USSR)); Litvin, I.S. (Tepleolektroproyekt Inst., Leningrad (USSR)). pp 673-684 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Some problems are discussed associated with the need for reducing the vibration level and ensuring high reliability of the machine-foundation-soil systems. The results of field, model and analytical studies used in the design of new machine-foundation-soil systems are presented and compared.

2019 **Calculation of the loads induced by pressure wave-flow in branched piping in interaction to valve closing behavior.** Fautz, M. (Kraftwerk Union A.G., Offenbach am Main (Germany, F.R.). Hauptbereich Reaktortechnik). pp B2/5 (1-8) of Structural mechanics in reactor technology. Transactions. Vol. B. Thermal and fluid/structure dynamics analysis. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

Rapid changes in flows through a pipe, e.g. as a result of pipe ruptures or quick-closing/quick-opening valves, cause loads in the form of pressure waves which can have an effect throughout the whole piping system. A description of these fluid dynamic processes and knowledge of the resultant, time dependent forces are of great significance for the dynamic computation of the piping structure. For some time now the EUDRU Program has been available for use in performing such fluid-dynamic analyses. The program is suitable for analysing piping systems through which liquids, gases or homogeneous mixtures flow. Using combination elements such as branches and junctions together with dead ends, even complicated piping systems can be represented. Description of the conditions at the ends of the
ent pressure or mass flow functions.

2020 **'Buffeting of single cylinders'.** Savkar, D.D.; So, R.M.C. (General Electric Co., New York (USA)). pp 189-204 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The fluctuating lift and drag induced on a rigid cylinder immersed in a turbulent flow in the range of Reynolds numbers straddling the transition from subcritical to supercritical regime is examined. The buffeting forces are induced in response to turbulence generated by grids. In the present experiments, the integral scales of turbulence, l, for the grids used are less than the cylinder diameter ($l/d < 1$). Interpretation of these and other published data strongly suggest that the free stream disturbances (turbulence) affect the force response in two ways. In the absence of grid turbulence below a certain threshold level, it appears to simply modulate the spanwise spatial coherence of vortex shedding. In this situation, the spectral character retains the discrete or monochromatic Strouhal nature, while the RMS force levels decrease with increase in the measured free stream disturbance. On the other hand, the cylinder response to broad band excitation by the high intensity grid generated turbulence is no longer discrete although the spectral character still retains a 'humped' shape of a band pass filter. Centre band frequency of this band pass is very nearly, although not quite, the Strouhal frequency in the 'clean' flow. In any event, the RMS amplitudes continue to decline as the turbulent intensity is increased. While the evidence is suggestive, it is not as yet completed.The data on hand strongly suggest the domination of the cylinder buffeting phenomenon by the shed wake, at the lease for $l/d < 1$. A principle can also be extracted from the data. The persistence of the Strouhal frequency into the buffeting response spectrum suggests that the time scale so represented is inherent to flow/cylinder interactions even when the upstream flow is highly turbulent (and $l/d < 1$).

2021 **Tube bundle vibrations in transversal flow.** Gibert, R.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Chabrerie, J.; Sagner, M. pp 205-213 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The vibrations induced in tube arrays by a transversal flow are of great practical interest because of their destructive effects especially on heat exchangers. Though turbulence can significantly excite the tubes by itself, most intense vibrations are still caused by two fluidelastic phenomena, the 'lock-in' effect, and whirling instability. The study described gives important information concerning characteristic parameters about both phenomena, in the case of tube arrays. The work is mainly experimental though models are also developed.

2022 **Vibration of heat exchange components in liquid and two-phase cross-flow.** Pettigrew, M.J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.); Gorman, D.J. (Ottawa Univ. (Canada). Dept. of Mechanical Engineering). pp 215-232 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Heat exchange components must be analysed at the design stage to avoid flow-induced vibration problems. Information required to formulate flow-induced vibration excitation mechanisms in liquid and two-phase cross-flow is presented. Three basic excitation mechanisms are considered, namely: 1) fluidelastic instability 2) periodic wake shedding and 3) response to random flow turbulence. The vibration excitation information is deduced from vibration response data for various types of tube bundles. Sources of information are: 1) fundamental studies on tube bundles, 2) model testing 3) field measurements and 4) operating experiences. Fluidelastic instability is formulated in terms of dimensionless flow velocity and dimensionless damping; periodic wake shedding in terms of Strouhal number and lift coefficient; and random turbulence excitation in terms of statistical parameters of random forces. Guidelines are recommended for design purposes.

2023 **Fluid-elastic vibrations in heat exchangers with tubes in cross-flow.** Heinecke, E.P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). pp 233-237 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Tube vibrations in tube banks with tubes in cross-flow have been studied. Special interest has been devoted to fluid-elastic vibrations. A simple mathematical model to describe the coupling between the instationary flow and the vibrating tubes is given. Finally a method to suppress high amplitude vibrations is discussed.

2024 **Flow structure within both stationary and vibrating tube banks with triangular pitch.** Zdravkovich, M.M. (Salford Univ. (UK)); Namork, J.E. (Norske Veritas, Oslo). pp 239-248 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Systematic research has been carried out at Salford on a closely packed tube bank in one triangular pitch arrangement. The time average and fluctuating pressure distribution were measured around a tube positioned either in the first or second row within both stationary and vibrating tube banks. The amplitude-frequency spectra of pressure fluctuations were computed for signals taken at various circumferential locations around the tube. The frequency peaks due to the modified vortex shedding, acoustic resonance and vibration of tubes were detected, identified and compared for both the stationary and vibrating tube banks. The discussion and interpretation of results highlights the distinct features of the interstitial flow structure and its modification owing to tube vibration.

2025 **Criteria for the cross-flow-induced tube vibrations in tube bank heat exchangers.** Chen, Y.N. (Sulzer Bros. Ltd., Winterthur (Switzerland)). pp 249-271 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Properties of the various excitation sources of cross-flow-induced vibrations in tube bank heat exchangers, such as Karman vortex shedding, wake swing, jet switch, jet instability and fluid-elastic whirling are shown. The working charts are examined using the experimental results obtained on a heat exchanger with mixed cross-parallel flow. It is shown for the present case that only the coupled second bending mode of the entire tube can be excited by the flow due to its S-shaped pattern. The hydrodynamic added mass is then discussed. The investigation shows that the added mass of a tube in a cross flow is far less than that in a stationary fluid. It is therefore recommended that great care be taken when transferring data from stationary fluid tests to prototypes working with dense fluid across tubes.

2026 **Overview of the subject of liquid cross-flow induced vibration of heat exchanger tube bundles.** Gorman, D.J. (Ottawa Univ. (Canada). Dept. of Mechanical Engineering). pp 273-277 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

An attempt is made to review the present status of technology related to liquid crossflow induced vibration of tube bundles, particularly as it pertains to problems of design. The dominant mechanisms of excitation are treated separately and current design practices, as discussed in the literature, are reviewed. Some areas where it is considered that further research would be beneficial are identified.

2027 **Avoiding vibration-induced tube failures in shell and tube heat exchangers.** Franklin, R.E. (Oxford Univ. (UK)); Soper, B.M.H.; Whittle, R.H. (UKAEA Atomic Energy Research Establishment, Harwell). pp 287-295 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The past few years has seen a very significant increase of activity in heat exchangers tube vibration research, both analytical and experimental. Some of the results of this work are examined and discussed in the context of how best they may be applied in the assessment of heat exchangers at the design stage. Special attention is focussed on the overall picture and on the simplifications which can be made in many instances.

2028 **Vibration tests of single heat exchanger tubes in air and static water.** Collinson, A.E.; Warneford, I.P. (UKAEA Risley Nuclear Power Development Labs.). pp 307-325 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The vibrational characteristics of a 7 span straight tube and a 26 span U-tube have been investigated for the effects of fluid medium (air/water), tube-grid clearance, tube-grid contact force, vibration transmission and scale. Measured frequency response and mode shapes compared favourably with theoretical values, vibration with pin-pin tube support being most readily excited. The frequency reduction on immersion in water corresponded to an added mass equivalent to the liquid displaced mass. Dynamic magnifiers varied in the range 12-135 with mean values of 30-40 in water and 45-60 in air. Principal vibration modes and damping values were reproducible in a half-scale model of a U-tube.

2029 **Buffeting of heat exchanger tube arrays in a cross flow.** Blevins, R.D. (General Atomic Co., San Diego, CA (USA)). pp 327-330 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

A model for turbulence-induced vibration of tube arrays in a cross flow is presented and compared with experimental data. The model is based on random vibration theory. The model is found to provide reasonable agreement with experimental data for tube arrays not subject to instability.

2030 **Duct acoustic resonances induced by flow over coiled and rectangular heat exchanger test banks, of plain and finned tubes.** Bryce, W.B. (Babcock and Wilcox Ltd., Renfrew (UK)); Wharmby, J.S. (Babcock and Wilcox Ltd., London (UK)); Fitzpatrick, J. (Glasgow Univ. (UK)). pp 331-347 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The generation of acoustic resonances in ducts of rectangular and circular cross-section by gas flow over straight and coiled tube heat exchanger banks contained in the ducts has been studied. It has been shown that there is a distinct difference in behaviour between shallow heat exchanger banks, ie less than 40 rows deep, and deep banks, ie greater than 50 rows deep. It has also been shown that there is a distinct difference between the behaviour of finned tubes and plain tubes which is also dependent on the method of supporting the tubes. Some of these features can be predicted from theory but other aspects cannot as yet be explained by theory.

2031 **Some observations of the pressure distribution in a tube bank for conditions of self generated acoustic resonance.** Fitzpatrick, J.A. (Glasgow Univ. (UK)); Donaldson, I.S.; McKnight, W. (Queen's Univ., Belfast, Northern Ireland (UK)). pp 349-361 of Vibration in nuclear plant. Vol. 1. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The results for mean and fluctuating pressure distributions around tubes in an in-line tube bank are presented for both non-resonant and self-excited acoustic standing wave resonant flow regimes. It is readily deduced that the nature of the flow in the bank is dramatically altered with the onset of acoustic resonance. The velocity gradients which appear across the bank with the onset of resonance would suggest regions of flow recirculation in the bank although no evidence of this was found. The spectra of fluctuating pressure on the duct roof in the bank and on tubes deep in the bank exhibited coherent peaks only during resonance.

2032 **Machine fault detection and failure prediction via measurement of the dynamic response in the frequency domain.** Davall, P.W.; Gupta, M.M.; Ukrainetz, P.R. (Saskatchewan Univ., Saskatoon (Canada)). pp 709-727 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

It is shown that some common machine structural failures can be identified on-line by monitoring in some chosen characteristic frequency response functions. The response signatures are shown to be insensitive to variations in machine loading and, by suitable location of vibration monitoring points, can be used to accurately locate and identify the cause of failure. The method is used to identify faults such as shaft misalignment and bearing failures on a high speed motor-pump assembly and to detect and predict fatigue failures in shafts subjected to torsional loads.

2033 **Response of pressure vessel steel specimens on drop weight loading.** Winkler, S.; Kalthoff, J.F. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Freiburg im Breisgau (Germany, F.R.). Inst. fuer Festkoerpermechanik); Gerscha, A. pp G4/6 (1-9) of Structural mechanics in reactor technology. Transactions. Vol. G. Structural analysis of steel reactor pressure vessels. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

Load records obtained in instrumented impact tests in general are disturbed by inertia effects. The influence of mechanical damping provisions on these disturbing inertia effects is investigated. Precracked bend specimens are dynamically loaded in a drop weight testing system. The specimens of size 620 mm x 150 mm (25 mm or 50 mm thick) were machined from the pressure vessel steel 22 NiMoCr 37 which was heat treated to achieve a specially hardened condition. The tests were performed at two different low temperatures. The impact velocity was about 4 m/s. As it is usual in instrumented impact testing, the load at the tup of the impining striker is recorded as a function of time during the impact process. In addition the specimen is instrumented by a strain gage close to the crack tip in order to directly measure the stress intensification. Experiments were performed under pure and damped impact conditions. Damping was achieved by utilizing a soft aluminum plate between the striker and the specimen.

2034 **Effect of past loading on the current stress of rigid plastic materials.** Lee, Y.S.; Bohm, G.J.; Swamy, S.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Technology Div.). pp L7/2 (1-10) of Structural mechanics in reactor technology. Transactions. Vol. L. Materials modeling and inelastic analysis of metal structures. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

This paper discusses the application of the concept of fading memory in plastic states in relation to the current methods used when stress analysis is performed for load levels above yield stress. Examples with materials used in nuclear industry are provided and results of the analysis are discussed. The study considers the effect of past loading history on the current plastic states of rigid plastic strain and strain rate hardening materials, with various exponents. The stress, strain, or strain rate distribution in a thick wall cylinder is obtained when the cylinder is subjected to single or multiple step function internal pressure under plane strain conditions. Stress distribution in a cantilever and fixed-fixed beam with strain hardening materials subjected to a cyclic loading at the free end superimposed on the initial displacement or thermal stress is calculated using the finite element method. Multiple loading conditions results are compared with those found from single loading conditions.

2035 **Acoustic excitation of flexural modes in a pipe which incorporates a 90 degree radiussed bend.** Fahy, F.J.; Firth, D. (Southampton Univ. (UK)). pp 609-616 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

An experimental program has been carried out in order to investigate the excitation of resonant vibration in bent pipe structures by sound in the contained fluid for both air and water filled systems. The work has application to the vibration in coolant circuits of gas and liquid cooled nuclear reactors. It has been found that the low order flexural modes of the pipe cross section and the frequencies above which these modes may exist have a strong influence on the vibration response of such systems.

2036 **Acoustic and mechanical vibrations in liquid-filled pipework systems.** Wilkinson, D.H. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). pp 863-878 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

A method is described for predicting the response of general pipework systems to acoustic or mechanical excitation including fluid/structure interactions. Transfer matrices are derived for straight pipes for mitre, multi-mitre or curved bends, for discontinuities in area, thickness, material or immersion in an external fluid and for constraints with stiffness, damping and mass such as hangers, dampers etc. Equations representing boundary conditions, T-junctions or junctions of any number of arbitrary pipes and pumps or other sources of excitation are given. Comparison of the method with an L-shaped pipe experiment showed good agreement on acoustic resonant frequencies and mode shapes, and explained errors in the predictions of simpler theories as due to neglect of

fluid/structure interactions. The use of mechanical damping to prevent acoustic resonances is suggested.

2037 **Development in techniques of eddy current methods in in-service inspection.** Stumm, W. (Institut Dr. Foerster, Reutlingen (Germany, F.R.)). pp 9-15 of Periodic inspection of pressurized components. Discussion volume. Conference originally held London, 8-10 May 1979. London, England; Mechanical Engineering Publications for The Institution of Mechanical Engineers (1979).

From Conference on periodic inspection for pressurized components; London, UK (8 May 1979).

Periodic eddy current inspection of built-in reactor tubes and of surfaces is considered. The classical one-frequency method and its limits are discussed. The possibilities of multi-frequency methods at the inspection of plated surfaces and of built-in steam generator tubes are shown. A detailed computer study of the shape of individual defect signals from various defect types lead to the possibility to separate certain defect types. By using internal rotating probes with multi-frequency methods in built-in steam generator tubes a reliable information retrieval is achieved.

2038 **Discussion.** pp 17-91 of Periodic inspection of pressurized components. Discussion volume. Conference originally held London, 8-10 May 1979. London, England; Mechanical Engineering Publications for The Institution of Mechanical Engineers (1979).

From Conference on periodic inspection for pressurized components; London, UK (8 May 1979).

The discussion of the papers included reference to the following aspects of the subject: design and inspection of nuclear plant pressure components; ultrasonic inspection; eddy current testing; acoustic emission testing; crack growth; data processing; on-line system for monitoring flaws; accuracy and reliability of tests and interpretation of results.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 1975, 1976

2204 Control Systems

2039 **Interactive simulation of nuclear power systems using a dedicated minicomputer: computer graphics facility.** Tye, C.; Sezgen, A.O. (Manchester Univ. (UK). Dept. of Nuclear Engineering). pp 213-221 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

The design of control systems and operational procedures for large scale nuclear power plant poses a difficult optimization problem requiring a lot of computational effort. Plant dynamic simulation using digital minicomputers offers the prospect of relatively low cost computing and when combined with graphical input/output provides a powerful tool for studying such problems. The paper discusses the results obtained from a simulation study carried out at the Computer Graphics Unit of the University of Manchester using a typical station control model for an Advanced Gas Cooled reactor. Particular reference is placed on the use of computer graphics for information display, parameter and control system optimization and techniques for using graphical input for defining and/or modifying the control system topology. Experience gained from this study has shown that a relatively modest minicomputer system can be used for simulating large scale dynamic systems and that highly interactive computer graphics can be used to advantage to relieve the designer of many of the tedious aspects of simulation leaving him free to concentrate on the more creative aspects of his work.

2040 **Control systems. Chapter 6.** Dollezhal, N.A.; Emel'yanov, I.Ya. pp 102-138 of Kanal'nyj yadernyj ehnergeticheskij reaktor. Moscow, USSR; Atomizdat (1980). (In Russian)

The power distribution control and regulation systems for the RBMK reactor are described in detail. Among the specific features of the reactor effecting its control underlined are complexity and nonstability of the power distribution and a large amount of the control points. Flowsheets and basic parameters of subsystems for physical control of the power spatial distribution as well as of the reactor control soft- and hardware are presented. A technique for calculating power generation in a fuel assembly is given. The design of detectors and neutron absorbers used in the control systems is described. The reactor electronic instrumentation is shortly cons ed. Considered are also the problems of optimization of the reactor dynamics and effects of the external circuits on the reactor performance. The importance of experimental studies for checking the reactor control theory is highlighted.

2041 **Reactor control instrumentation complex. Chapter 7.** Dollezhal, N.A.; Emel'yanov, I.Ya. pp 139-152 of Kanal'nyj yadernyj ehnergeticheskij reaktor. Moscow, USSR; Atomizdat (1980). (In Russian)

The problem of providing for optimum operation of the RBMK type reactors and NPP based on such reactors brought about the necessity of developing the multichannel and multifunctional automated system for the centralized control, conditionally named Skala. Presented and described are the flowsheets and design criteria of main constituents of the subsystems for channel-to-channel flowrate control, temperature measurement, control of fuel channels and fuel element can integrity. Main operating functions of the Skala system as a whole, their priority as well as hardware systems are discussed.

2042 **Treatment of flow-induced pendulum oscillations.** Hennig, K. (Akademie der Wissenschaften der DDR, Berlin); Grunwald, G. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). pp 477-485 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Flow-induced oscillations of reactor control elements were treated in model experiments with air as flowing medium. The treatment was centred upon the dependence of the vibration behaviour of the rod elements on the airflow rate. This report shows the experimental and theoretical results.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 2470

2043 **Radiation protection of atomic radiation workers.** Watson, D.A. (Ontario Hydro, Toronto (Canada)). pp vp of Proceedings of the symposium on CANDU reactor safety design. Toronto, Ontario, Canada; Canadian Nuclear Association (1978).

From Symposium on CANDU reactor safety design; Toronto, Canada (Nov 1978).

Ontario Hydro has been operating nuclear power stations at various locations in the province since 1962. The radiation protection program for personnel employed as Atomic Radiation Workers emphasizes self-protection based on knowledge of the hazards involved and good practice. The program at operating stations is administered by line management in the Nuclear Generation Division and supported by expertise in the Health and Safety Division. Protection of employees from the harmful effects of radiation is a prime concern in the design of nuclear stations and radiation exposure of personnel has been significantly reduced through design improvements. The radiation protection program to date has maintained an enviable record. There have been no acute fatalities, or injuries due to radiation exposure and no acute doses in excess of permitted limits. Future efforts by Design, Operations and Health and Safety should ensure continuation of this performance.

2206 Research, Test, And Experimental Reactors

2044 (EUR—6813(Vol.1), pp 599-609) **Fast neutron spectrum measurement in the JMTR.** Sakurai, K.; Mizuho, M. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). 1980. Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Fast neutron spectrum measurement at positions of K-10 (fuel region), J-11 (first beryllium reflector region) and I-12 (second beryllium reflector region) in the JMTRC has been performed with the threshold detectors such as ^{107}Ag(n,n')sup(107m)Ag, ^{103}Rh(n,n')sup(103m)Rh, ^{115}In(n,n')sup(115m)In and ^{238}U(n,f)F.P. above 0.1 MeV energy region. The activity data have been analyzed by the unfolding code SAND-II using ANISN spectrum for initial spectrum. An effective cross section of ^{54}Fe(n,p)^{54}Mn is calculated with Fabry's cross section data and SAND-II spectrum for K-10, J-11 and I-12. They are 76.7 mb, 69.0 mb and 68.2 mb for K-10, J-11 and I-12 respectively. These values agree with the effective cross sections (calculated by Fabry's cross section data and ANISN spectrum) within +-6%.

2045 (EUR—6813(Vol.1), pp 610-619) **Dosimetry measurements in the mixed (neutron and gamma) radiation field of the Budapest Technical Universities' nuclear reactor.** Zsolnay, E.M.; Viragh, E.; Szondi, E. (Budapest Technical University (Hungary)). 1980. Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Activation and thermoluminescent detectors were used as neutron and gamma radiation indicators. With aid of the irradiated activation detectors the neutron spectrum was determined using the unfolding procedure of the computer program SAND-II. Thereafter the absorbed neutron dose was calculated for some materials. The TL detectors, ^{6}LiF and ^{7}LiF, were used as thermal neutron and gamma dose indicators, respectively. Some experimental results are also presented concerning radiation damage investigations of some insulators and adhesive materials used in the first Hungarian nuclear power plant being under construction.

2046 (EUR—6813(Vol.1), pp 645-652) **Measurement and calculation of fluence, spectra and tissue kerma at large distances from a fission source.** Kazi, A.H.; Heimbach, C.R.; Harrison, R.C. (Aberdeen Proving Ground, MA (USA)); Schanzler, L.; Buchholz, F.W. (Wehrwissenschaftliche Dienststelle, Muenster (Germany)). 1980. Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

An experimental program is underway at the Army Pulse Radiation Division reactor (APRDR) at Aberdeen Proving Ground, Maryland, to provide benchmark quality radiation transport data characterizing an air-over-ground environment. The data are used to evaluate analytical radiation transport models and provide validation for techniques used to measure radiation protection or shielding of various materiel. The APRDR is a bare critical assembly fueled with uranium ten weight percent molybdenum alloy. For this application the reactor is operated outdoors 14M above ground. Todate measurements have been made by both US and German scientists of neutron and gamma fluence, spectra, and kerma at ranges from 1 to 400 meters from the reactor.

2047 (KURRI-TR—192, pp 18-23) **Nuclear calculation for employing medium enrichment in reactors of Japan Atomic Energy Research Institute.** Miyasaka, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). 1979. (In Japanese). Dep. NTIS (US Sales Only).

From Meeting on research reactors using middle-enrichment uranium; Kumatori, Osaka, Japan (30 Jan 1979).

The fuel used for the research reactors of Japan Atomic Energy Research Institute (JAERI) is presently highly enriched uranium of 93%. However, the US government (the supplier of fuel) is claiming to utilize low or medium enriched uranium from the viewpoint of resistivity to nuclear proliferation, and the availability of highly enriched uranium is becoming hard owing to the required procedure. This report is described on the results of nuclear calculation which is the basis of fuel design in the countermeasures to the reduction of enrichment. The basic conception in the reduction of enrichment is three-fold: to lower the latent potential of nuclear proliferation as far as possible, to hold the present reactor performance as far as possible, and to limit the reduction in the range which is not accompanied by the modification of reactor core construction and cooling system. This time, the increase of the density and thickness of fuel plates and the effect of enrichment change to 45% on reactivity and neutron flux were investigated. The fuel of UAl/sub x/-Al system was assumed, which was produced by powder metallurgical method. The results of investigations on JRR-2 and JMTR reactors revealed that 45% enriched fuel does not affect the performances much. However, deterioration of the performances is not neglegible if further reduction is needed. In future, the influence of the burn-up effect of fuel on the life of reactor cores must be investigated.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 1981, 2550

2048 (INIS-mf—6285, pp 138-151) **Effort on Nuclear Power Plants safety.** Prayoto. 1979. (In Indonesian). Dep. NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Prospects of nuclear power plant on designing, building and operation covering natural safety, technical safety, and emergency safety are discussed. Several problems and their solutions and nuclear energy operation in developing countries especially control and permission are also discussed.

2049 (INIS-mf—6285, pp 183-192) **Advantages and hazards of the installation of Nuclear Power Plants.** Somadiredja, S. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Advantages and hazards of nuclear power plants, containing reactor safety, cost of reactor safety program, and environmental problems are presented.

2050 **Effectiveness of a whole-body counter during and after an accident situation at nuclear facilities.** Berger, C.D. (Oak Ridge National Lab., TN (USA)). *Health Physics;* **40**: No. 5, 685-692(May 1981).

Nuclear facilities must have the capability of rapid assessment of body burdens of radionuclides as part of their emergency preparedness plans. A recent incident at a commercial nuclear plant has shown that the whole-body counters in force were most useful in achieving the above, but incidents of improper data acquisition and analysis resulted in questionable assignments of body burden. If this incident had been more severe, there could have been significant errors in dose assessment. With respect to quality control, the areas of concern were background subtraction techniques, personnel entrance procedure, counter location, and electronics stability. Whole-body counting is a useful methodology for internal dose assessment if attention is paid to procedure and generalized operations. Recommendations are presented to aid in acquisition of reliable results during routine operations as well as emergency situations.

2051 **HEXECO code - a six-equation model.** Houdayer; Pinet; Vigneron (Electricite de France, 92 - Courbevoie. Service Etudes et Projets Thermiques et Nucleaires). pp 99-105 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 1. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

HEXECO code is used to analyse experiments, to test physical assumptions, to establish the connection between different experiments and will be used to the transposition to the reactor. In spite of numerical difficulties in several cases, it works in a lot of

instances. First analysis of experiments gave preliminary correlations in the field of blowdown and critical flow. This work has to be improved, and interpretations of other experiments are needed to extend the validity of constitutive laws to all the flow patterns, dimensions and pressures we need for LOCA studies.

2052 **Development of a blowdown code for the simulation of steam water separation effects (water level problems) on the basis of the nonequilibrium code DRUFAN.** Steinhoff, F. pp 243-280 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 1. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

The nonequilibrium lumped parameter blowdown code DRUFAN, used to analyse loss-of-coolant accidents, has been extended to calculate the motion of the mixture respectively, water level inside the reactor vessel. Some important features of this mixture level model are: several mixture level tracks may be simulated either in parallel or in series; mixture level tracks may have branchings up, down or to the side; transition of the mixture level from one control volume into another is possible. The first mixture level calculations with DRUFAN were made with Standard Problem 6. The DRUFAN results were in good agreement with the experimental data.

2053 **SUPER CANON experiments.** Rousseau, J.C.; Riegel, B. pp 667-686 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 2. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

It has been demonstrated that, even for large pipe wall thicknesses, supporting high pressures, the neutron scattering method allows good mean void fraction measurements with high contrasts. This method has been used for the evaluation of the void fraction evolution during the fast blowdown of the SUPER CANON apparatus. The neutrons were issued from a pile which delivered a flux of about 10^7 fast and epithermal neutrons/cm^2 (the same attempt was made using a californium neutron source of 10^8 n/4 π. The results were simular, but the weakness of the source did not allow us to operate in fast transients). Great care was taken in establishing the calibration curve, and particularly the temperature effect correction of the neutron scattering method. The SUPER CANON tests (Initial pressure 150 bars. Initial temperature 300°C) have been predicted by the SERINGUE and the BERTHA codes, both taking into account a thermal non equilibrium. Comparisons of calculated and measured void fractions have been made and a good agreement obtained, so it can be considered that the calculated mass flow rate at the break during the blowdown is predicted with sufficient accuracy.

2054 **Grid disconnection trip strategy for a Benson system cycle in fast-reactor power plant.** Knowles, J.B. (UKAEA Atomic Energy Establishment, Winfrith); Farrier, D.R. (Southampton Univ. (UK)). pp 21-27 of Boiler dynamics and control in nuclear power stations 2. Proceedings of the second international conference held in Bournemouth, 23-25 October, 1979. London, England; British Nuclear Energy Society (1980).

From 2. international conference on boiler dynamics and control in nuclear power stations; Bournemouth, UK (23 Oct 1979).

Several complete grid disconnections are likely in the life of a sodium-cooled fast-reactor power station. Under these circumstances, the feedwater temperature falls rapidly and due to highly efficient heat transfer processes, significant thermal shocks may be inflicted on the boiler and IHX tube-plates. Saturated steam cycle proponents in the USA have claimed that standby tanks of preheated feedwater are necessary with Benson and Sulzer cycle units in order to achieve adequate buffering of these temperature transients. A more cost-effective solution to this problem is now proposed which is based on suitable feed trip timing. In addition interpolative heat flux functions are investigated as a possible means of reducing the number of spatial mesh points in the boiler model and its computation time.

2055 **ICRP publication 26. Its applicability in a nuclear power programme.** Wilson, R.; Donnelly, K. (Ontario Hydro, Toronto (Canada)). pp 3-27 of Occupational radiation exposure in nuclear fuel cycle facilities. Proceedings of a symposium jointly organized by the IAEA and the OECD NEA and held in Los Angeles, 18-22 June 1979. Vienna, Austria; IAEA (1980).

From IAEA international symposium on occupational radiation exposure in nuclear fuel cycle facilities; Los Angeles, CA, USA (18 Jun 1979).

Ontario Hydro is a major Canadian provincial utility with more than 5 GW(e) installed nuclear electricity generating capacity and with a planned commitment to an additional 8.5 GW(e), all units being of the CANDU pressurized heavy-water type. The radiation protection programme, in addition to complying with Canadian Federal regulations, has been consistent with the philosophy and intent of ICRP recommendations and is frequently reviewed to ensure compliance with these recommendations, the most recent of which is ICRP-26. The application of the ALARA principle in this power reactor programme is described. A set of general guidelines has been established, the main features of which are: (a) achieving a dose consumption per unit of electricity generated which is low compared with reactors of a similar type; (b) ensuring that stations are operable with the dose equivalent of their labour-dictated manpower; (c) ensuring that the risk to atomic radiation workers is compatible with a corporate fatality rate standard of <6 fatalities per 10^8 man-hours worked. Achievement of these guidelines has necessitated implementing a continued dose-management programme. This programme is described generally. The cost applied to justify a dose reduction of 1 man.Sv is given, and a comparison is made with the equivalent life costs this implies and the costs used by safety agencies for other risk-reductionactivities. Finally, some practical problems associated with some of the recommendations of ICRP-26 are discussed.

2056 **Information relative to Zircaloy embrittlement criteria and emergency core-cooling systems.** Chung, H.M. (Argonne National Lab., IL (USA)). pp 758-764 of Proceedings of Korea symposium on science and technology. Seoul, Korea; Korean Federation of Scientific and Technological Societies (1980).

From 7. Korea symposium on science and technology; Seoul, Republic of Korea (13 Jul 1979).

The embrittlement characteristics of oxidized Zircaloy cladding are studied. The capability of zircaloy cladding to withstand thermal-shock and mechanical loads is determined under postulated loss-of-coolant-accident (LOCA) and power-coolant-mismatch (PCM) situation in light-water reactors (LWR's). And then, cladding-embrittlement criteria applicable to LOCA and PCM are suggested.

2057 **Method of evaluation of failure rate of equipment and pipings under excess-earthquake loadings.** Shibata, H. (Tokyo Univ. (Japan). Inst. of Industrial Science); Okamura, H. (Tokyo Univ. (Japan). Dept. of Marine Engineering). pp K2/6 (1-8) of Structural mechanics in reactor technology. Transactions. Vol. K(a). Seismic response analysis of nuclear power plant systems. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

This paper deals with a method of evaluation of the failure rate of equipment and pipings in nuclear power plants under an earthquake which is exceeding the design basis earthquake. If we put the ratio of the maximum ground acceleration of an earthquake to that of the design basis earthquake as n, then the failure rate or the probability of failure is the function of n as p(n). The purpose of this study is establishing the procedure of evaluation of the relation n vs. p(n).

2058 Design considerations for application of metallic honeycomb as an energy absorber. Lee, W.H. (Tennessee Valley Authority, Knoxville (USA)); Roemer, R.E. (Stone and Webster Engineering Corp., Boston, MA (USA)). pp F7/1 (1-8) of Structural mechanics in reactor technology. Transactions. Vol. F. Structural analysis of reactor core and coolant circuit structures. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

Design for postulated accidents in nuclear power plants often requires mitigation of impact to safety-related structures. Elasto-plastically designed, energy absorbing mechanisms are often used in the design of such mitigating structures in order to substantially reduce potentially high structural loads and dissipate the kinetic energy of a whipping pipe, dropped fuel cask, or internally generated misile. Several deformable materials are available which will absorb the levels of kinetic energy associated with nuclear design requirements. Of these materials, metallic honeycomb delivers the lowest load to the substructure for a given energy and deformation level since its behavior best approximates the rigid, perfectly plastic behavior of an ideal energy absorber over large absorption displacements. Consequently, honeycomb is highly desirable in applications where the impactive load governs the structural design and minimization of such loads is required for reasons of overall economy. Current design methods for the application of metallic honeycomb as an energy absorber have generally been based on experience with the static behavior of the material under parallel-platen compression tests. Consequently, the use of honeycomb is limited to parallel face compression and only those characteristics which become evident under static test loading conditions are generaly considered indeveloping the overall design of the impact mitigating device. The paper reviews current design practices. It finds them acceptable in the context of their experimental basis but suggests additional significant areas which could be considered to further assure the predicable performance of impact mitigating structures designed with parallel cell metallic honeycomb.

2059 Speed of propagation of pressure waves in fast reactors. Thorley, A.R.D. (The City Univ., London (UK)). pp 891-897 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Although a molten fuel-coolant interaction can generate large amplitude pressure pulses the consequences of plastic deformation of the duct in which they occur leads to rapid attenuation of the pressure pulse. The ongoing pressure pulse is then limited to a pressure below that at which plastic yielding of the duct walls occurs. An equation for predicting the speed with which these ongoing pressure waves are propagated in hexagonal ducts is presented. It shows a favourable comparison with experimental data.

2060 Seismic analysis of a large-diameter piping system, CANDU 600 MWe series. Deksnis, E.B. (Canatom Ltd., Montreal, Quebec (Canada)). pp 931-942 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The seismic response of a large-diameter piping system, supported by and restrained from several independent structures, is calculated. A model made up of pipe members and lumped-parameter representations of each building is analyzed by the response spectrum method. The usual rules for synthesis of the total response from individual modal components are modified to eliminate spurious chains of closely-spaced, but independent mode. Simplified alternative models are examined for the building-piping interaction.

2061 Approximate analytical method for seismic response of structure having elastoplastic behaviour. Abe, T.; Fujikawa, T.; Kurohashi, M.; Inoue, Y. (Kobe Steel Ltd. (Japan)). pp 943-955 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The author has proposed an approximate method to practically analyze the seismic responses of structures which have elastoplastic characteristics. In this method non-elastic equation of motion is equivalently linearized and solved by modal analysis method. Approximate solutions are compared with the direct integral solution or test result in some vibrating system models. It may be predictively said that the proposed method is proved to be applicable enough in practical cases.

2062 Response spectra in seismic design of nuclear power plants. Scanlan, R.H. (Princeton Univ., NJ (USA)); Sachs, K. (Kraftwerk Union, Offenbach (Austria)). pp 957-967 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The method, common in the United States, of establishing and applying seismic design criteria for nuclear power plants, is briefly reviewed. Prominent in this approach is the specification of a primary design response spectrum. A critical examination of this and attendant devices is given, followed by an outline of a design method (Fourier treatment) in which both primary and secondary design response spectra that are independent of particular earthquake time-history formulations are generated and used.

2063 Confirmation of the aseismic design of the sodium pipings by using the natural micro motions. Kobatake, K.; Ooka, Y.; Suzuki, M.; Okuda, T.; Katsuki, T. (Kawasaki Heavy Industries Ltd., Tokyo (Japan). Nuclear Power Plant Div.). pp 969-979 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

For the confirmation of aseismic design of the sodium pipings with those supporting frame work, three kinds of vibration tests have been performed; forced by exciter, excited by manpower, and of natural micro motions. From these test results and the analysis, the vibration test of natural micro motions was confirmed to be applicable, and a 3 dimensional model can get more precise results in the case of the complicated structure.

2064 Seismic isolation system for nuclear plant. Derham, C.J. (The Malaysian Rubber Producers' Research Association, UK); Kelly, J.M. (California Univ., Berkeley (USA). Earthquake Engineering Research Center). pp 981-992 of Vibration in nuclear plant. Vol. 2. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

A series of experimental tests is described in which the feasibility and reliability of a proposed system for isolating nuclear power plants and/or large components within them from earthquake attack are assessed. Two systems were tested each using a novel design of natural rubber structural bearing, in one case with the addition of energy-absorbing devices based on the large plastic torsion of mild steel bars. The bearings are designed in such a way that their horizontal stiffness is very much less (by a factor of 400) than their vertical stiffness. A computer study of a possible system has previously suggested that accelerations in structures isolated by rubber bearings can be reduced ten fold as compared to non-isolated structures. Experimental results now suggest that this high level of protection against seismic attack can indeed be provided by this isolation system.

2065 **Problem of the transient post-failure pressure waves 1.** Dzhupanov, V.A. (Bylgarska Akademiya na Naukite, Sofia). pp 879-890 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The post-failure behaviour of the moderator liquid in a channel type nuclear reactor is considered. The physical structure of the system is described followed by the initial wave properties, from which the scattering function may be determined.

2066 **Experimental studies of PWR primary piping under LOCA conditions.** Cauquelin, C. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)); Caumette, P.; Garcia, J.L.; Sermet, E. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). pp F6/1 (1-8) of Structural mechanics in reactor technology. Transactions. Vol. F. Structural analysis of reactor core and coolant circuit structures. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

Tests have been performed on a 1/10 th scale model to study the mechanical behavior of a primary PWR pipe and the forces exerted on the neighbouring structures as a consequence of a break opening. A number of tests have been carried out with different pipe configurations (straight tube, elbow, S or U shaped tube) and different break types (single or double guillotine). The following aspects are investigated: - the dynamic behavior of the pipe and in particular the formation of a plastic hinge at the restraint; - impact function of a pipe on an energy-absorbing bumper; - lateral stability of both ends of a pipe consequently to a guillotine break.

2067 **Response of an offshore floating nuclear plant to seismic forces.** Reddy, D.V.; Arockiasamy, M.; Haldar, A.K.; Babu, P.V.T. (Memorial Univ. of Newfoundland, St. John's (Canada)). pp 921-930 of Vibration in nuclear plant. Proceedings of international conference held at Keswick, UK in May 1978. London, England; British Nuclear Energy Society (1979).

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

The dynamic response to seismic forces of a floating nuclear plant restrained by mooring struts attached to the caissons within a protective breakwater is described. The floating platform is idealised as an equivalent thick plate. The reactor building is considered as a uniform shear-bending beam with lumped masses, the properties of which are based on frequency equivalence with the actual containment structure. The linear elastic mooring system with known strut stiffnesses, is idealised using beam elements. The Taft accelerogram is used for the excitation input at the ocean bed level and at all the mooring struts attached to the mooring caissons. Taking into account the hydrodynamic effects of the sea water, the time histories of displacements and stresses at typical sections are evaluated.

2068 (AECL—6958, pp 275-279) **CANDU reactor safety. A summary of evolution and current issues.** Snell, V.G. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

Nuclear risks are unique in that we lack historical experience of major accidents - the actual record shows less than one death in all of nuclear power operation. We postulate accidents in order to provide a basis for the plant design. Canada has long used numerical guidelines for the assessment of these postulated accidents. The author reviews how these guidelines have evolved, compares them to the real risks of nuclear power, and discusses recent public enquiries into safety in Ontario.

25 ENERGY STORAGE

2502 Compressed Gas

REFER ALSO TO CITATION(S) 1867

2069 **(DOE/ET/29232—T4-Vol.5-Pt.1) Compressed air energy Storage preliminary design and site development program in an aquifer. Turbomachinery design. Final report.** Berman, P.A.; Bonk, J.S.; Kobett, W.F.; Kosanovich, N.S.; Long, L.J.; Marinacci, D.J. (Public Service Co. of Indiana, Inc., Plainfield (USA); Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.). 31 Jul 1981. Contract AC02-78ET29232. 559p. NTIS, PC A24/MF A01. Order Number DE82000672.

Compressed Air Energy Storage (CAES) is a means of storing electrical energy generated by utility baseload power plants during off-peak hours. This stored energy will be used during periods of high demand. Compressed Air Energy Storage (CAES) system uses off-peak power from an electrical grid to operate an electric dynamo. This is used as a motor to drive a compressor train that charges atmospheric air at elevated pressure into an underground aquifer. During high electrical demand periods, the pressurized air is withdrawn from the aquifer and channeled to combustors where it is heated and then expanded through a combustion turbine. The turbine drives the electric dynamo, being operated as a generator, to supply power back to the grid. Since the CAES turbine train is divorced from the compressor during power generation, the net output power is about three times that of a normal combustion turbine. Although the fuel consumption rate is nearly the same, the heat rate is much lower thamined, and the methodologies used are described.

2506 Thermal

2070 **(CONF-810940—14) Survey of commercial thermal-storage installations in the United States and Canada.** Lorsch, H.G. (Oak Ridge National Lab., TN (USA); Franklin Research Center, Philadelphia, PA (USA)). 1981. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE82000131.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

Nearly 300 thermal energy storage installations in the United States and Canada were identified by a mail and telephone survey conducted by the Franklin Research Center. Information was obtained on approximately 220 installations. For 175 installations of hot, cold, and combination hot/cold storage, sufficient quantities of technical information were obtained to warrant inclusion in the report. Water is the most prevalent medium of energy storage. Although almost all respondents indicated satisfaction with the performance of their storage systems, hardly any could provide detailed performance records. Operational and construction cost data were either unobtainable or were not specified sufficiently to be useful. The project is continuing in two phases: publication of the survey data by ASHRAE, and development of detailed descriptions as well as performance and cost data for six representative installations.

2071 **(CONF-810940—15) Performance of stratified thermal-storage system for Oliver Springs Elementary School. Progress report.** Reid, R.L.; Bedinger, A.F.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE82000109.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

A progress report is given on the performance of a stratified thermal storage system coupled with a heat recovery refrigeration machine designed to provide space heating, cooling and service water heating. Water storage tanks utilizing a flexible membrane to resist temperature blending will be used as the thermal storage element. The two design goals of the heat recovery and thermal energy storage system are (1) to minimize the need to purchase energy for space heating and cooling and water heating and (2) to

minimize electrical demand. An automatic data acquisition system will be used for system performance and data gathering. Data collection is expected to begin in September, 1981.

2072 **(CONF-810940—17) Pelletization and roll encapsulation of phase-change materials.** Chen, J. (Oak Ridge National Lab., TN (USA); Pennwalt Corp., King of Prussia, PA (USA). Research and Development Dept.). 1981. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01. Order Number DE82000162.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

Based on the criteria of high latent heats of fusion, low cost, and ease of pelletization, seven phase change materials (PCMs) with melting points in the ranges suitable for absorption cooling, active heating, and passive space conditioning applications have been pressed into pellets about 12 mm in diameter and then encapsulated with organic coating materials by a roll coating process. Capsules of four of the seven PCM candidates have shown retention of integrity in various aqueous heat exchange fluids in accelerated thermal cycling tests ranging between 1500 to 2900 heating and cooling cycles. Capsules of PCMs melting near room temperature have also shown good stability in laboratory air environment. The objective of this effort is to develop reliable and cost effective PCMs for use in: (i) active heat exchange packed-bed assemblies of simple design that are capable of providing heat exchange efficiency and storage capacity superior to those of conventional heat storage systems, and (ii) passive heat storage systems consisting of building products incorporating thermal energy storage (TES) materials. The feasibility of this approach is supported by a favorable cost analysis.

2073 **(CONF-810940—19) Residential-scale ice-storage system for space cooling.** Hopkinson, H.H. (Oak Ridge National Lab., TN (USA); Carrier Corp., Syracuse, NY (USA). Energy Systems Div.). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE82000165.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

Energy load management is fast becoming a necessity to electrical utilities. Thermal cool storage offers the utility a means of load management. The ice bank approach to thermal energy cool storage offers the most potential for development. Seasonal performance of both full and partial storage systems will be studied using a Carrier simulation program. These results will form the basis for selection of a system to be developed under this contract. Project work was started on Phase I during April 1981. The objectives of Phase I are the establishment of a conceptual design and completion of a marketing and economic study. Seasonal performance of the proposed equipment for several locations will be determined by computer simulation.

2509 Batteries

REFER ALSO TO CITATION(S) 2091

29 ENERGY PLANNING AND POLICY

2074 (INIS-mf—6285, pp 9-19) **National policy on energy field.** Zen, M.T. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

National energy policy on energy sources of geothermal energy, charcoal, water, radioactive mineral, solar energy and the implementation strategy are presented.

2075 (INIS-mf—6285, pp 20-41) **Energy policy of USA and the important aspects for Indonesia.** Arismunandar, A. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Energy policy of USA including several problems of energy, energy sources and the respons of the energy policy is presented. Several important cases of energy for Indonesia are also described.

2076 (INIS-mf—6285, pp 42-78) **Planning of electrical system in Indonesia.** Sardjono. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

Scope, development potention, distribution principle and disturbances of electric power plants in Indonesia are presented. Estimation of energy consumption is also described.

2902 Economics And Sociology

2077 **US economic position as an energy supplier and user.** Laffer, A.B. (Univ. of Southern California, Los Angeles). pp 93-105 of Coal production and transportation. San Francisco, CA; PLM, Inc. (1981).

From 7. annual conference on coal production and transportation; Houston, TX, USA (25 Feb 1981).

The author discusses the politics which are happening in the United States, and also the trends that are taking place. There is a shift from a redistributional society to what the author would like to refer to as a growthist society which he believes is not new and cites examples of times when United States went through this change. Growthists believe private and personal incentives are the primary determinants of economics and the role of government is not to redistribute income, but to provide an environment that allows for private expansion and private production in the overall economy. The author finds this change exciting and good for the economy of the nation. (ATT)

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 1772, 2501, 2502, 2503

2078 (AECL—6958, pp 319-322) **How dangerous is a nuclear reactor melt-down (question mark).** Cohen, B.L. (Pittsburgh Univ., PA (USA). Dept. of Physics). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

The dangers of nuclear power are placed in context by comparison with those of coal burning. The possibility and result of melt-down is discussed in terms of the containment and forces necessary to breach it. The number of fatalities is shown to be far less for a meltdown than for other types of non-nuclear disasters. For nuclear power to be as dangerous to the public as coal now is, there would have to be a meltdown every two weeks.

2904 Natural Resources

REFER ALSO TO CITATION(S) 1814

2079 (INIS-mf—6285, pp 79-84) **Function of charcoal in national energy program.** Kusuma, A. 1979. (In Indonesian). NTIS (US Sales Only).

From Workshop on economical technology of nuclear power plants; Bandung, Indonesia (29 Nov 1977).

National program of charcoal energy and the function are presented.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 2482

2080 **Framework for the 1982 DOE budget.** Edwards, J.B. *Energy Economics, Policy and Management;* **1**: No. 2, 8-17(Fal 1981).

Mr. Edwards observes that, energy-policy changes reflected in the 1982 DOE budget give the federal government a more-realistic role by letting the market price rather than controls and subsidies determine energy prices. He notes that the Reagan administration recognizes energy as an international issue and sees the need for balance between environmental and economic goals. Energy re-

search and development funding will turn commercialization over to the private sector and focus on long-term, high-risk programs and defense activities. The total DOE budget will drop from $14.3 billion in 1980 to $13.8 billion in 1982. Reductions occur in overall research and development, conservation, fossil energy, solar energy, and environmental budgets, with increases only in magnetic fusion, nuclear fission, energy-supporting research, general science, and defense. 11 tables. (DCK)

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 1868, 1981, 2078, 2502, 2503

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 2090

2910 Conservation

REFER ALSO TO CITATION(S) 2086

2081 **Summary of current states' industrial energy-conservation programs.** Anderson, R.; Evans, A.; Grogan, P. *Energy Economics, Policy and Management;* **1**: No. 2, 22-34(Fal 1981).

A report prepared at the end of the Carter administration outlines the organizational, financial, and technical plan for state industrial energy-conservation programs. These voluntary programs are based on a conservation goal set by the states in cooperation with the federal government, which provides technical and financial support. The organizational approach outlined shifts responsibility from the federal to the state level, but state responses and, consequently industrial benefits, were uneven. An editorial note questions the Reagan administration's lack of commitment to continue a program that accounts for 61% of the improvements in industrial energy conservation since 1972 and which exemplifies the goal of reducing the federal role. 3 references, 1 figure, 2 tables. (DCK)

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 2082

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 1731, 1734, 2077

2082 **National energy balance.** Brasilia-DF Brasil; Ministerio das Minas e Energia (1980). 104p. (NP—2900888). Ministerio das Minas e Energia, Esplanada dos Ministerios, Bloco J 70-056 Brasilia DF Brasil.

This illustrated brochure reviews the following: Brazilian energy policy; primary energy consumption; Brazilian energy reserves and resources; imported energy; hydro power; coal; firewood, cane bagasse, and charcoal; natural gas; alcohol; nuclear energy; new sources; oil shale, and petroleum. (MHR)

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 1719, 1724, 1730, 1731, 1744, 1745, 1746, 1747, 1748, 1749, 1750, 1751, 1752, 1754, 1755, 1756, 1757, 1759, 1762, 1762, 1763, 1763, 1764, 1764, 1765, 1765, 1766, 1766, 1768, 1768, 1770, 1770, 1772, 1774, 2078, 2446

2960 Electric Power

REFER ALSO TO CITATION(S) 2073, 2500, 2503, 2504

2083 **(IIASA-RR—80-27) Effects of accounting rules on utility choices of energy technologies in the United States.** Spinrad, B.I. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). 1980. 35p. Avail: Issuing Activity.

Comparisons of the costs of power systems, specifically the cost of nuclear versus other power systems, are discussed. The effects of inconsistent accounting are examined. Five systems that supply electrical power are cost analyzed: (1) light water reactors; (2) liquid metal fast breeder reactors; (3) coal plants, with scrubbers, burning low sulfur or processed high sulfur coal; (4) coal plants with fluidized bed combustion of high sulfur coal; and (5) solar power plants with sufficient storage for baseload use. Cost estimates for the system are made and justified. Cost comparison results show that, contrary to currently accepted conclusions, light water reactors have a decisive cost advantage over coal - if assumed target costs are met, after development, liquid metal fast breeder reactor would be the cheapest system - and if postdevelopment target costs are met, solar power plants are almost competitive with the nuclear systems and are much cheaper than coal. (ESA)

2084 **Electricity: report of the Secretary of State for Energy for the year ended March 31, 1980.** London, England; Department of Energy (1980). 15p. (NP—2900696). Her Majesty's Stationery Office, 49 High Holborn, London, England.

The following information is outlined in this pamphlet: personnel changes in the Central Electricity Generating Board (CEGB) and Area Electricity Boards (AEB) in Great Britain; the financial status and expenditures of the CEGB and AEB; and applications to existing power systems of Electricity Supply Regulations dating from 1882 to 1957. (LCL)

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 1813, 1829, 1835, 1836, 1845, 1847, 1863, 1865, 2082

2085 **(IIASA-RR—79-14) Solar options in central Europe. A synthesis of solar technology assessment and contemporary criteria in 1978 to 1979.** Bell, C.R. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). 1979. 32p. International Inst. for Applied Systems Analysis, Laxenburg (Austria).

Solar energy as a potential substitute for fossil fuels is evaluated, and the time phase in which solar technology can become a significant part of the energy supply mix is discussed. Constraints, such as the characteristic uncertainties of solar energy inputs, the developmental status of solar technology, and the evolution of other energy supply alternatives, are also described. The options that are at present most viable for solar energy exploitation in central Europe as well as the economic and technical parameters of these options are identified. A correlation with prototype data is made whenever possible to maximize the usefulness of the results.

30 Miscellaneous Converters

REFER ALSO TO CITATION(S) 2981

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

REFER ALSO TO CITATION(S) 1730, 2071, 2072, 2073

2086 **(DOE/CS/20364—T1) State energy codes for new buildings. Final draft report.** (National Conference of States on Building Codes and Standards, Inc., McLean, VA (USA)). Oct 1980. Contract AC01-79CS20364. 86p. NTIS, PC A05/MF A01. Order Number DE82000487.

The purpose of the study was to develop a current information base on adoption and implementation by states of energy conservation codes and standards for new buildings. Research efforts compiled information on (1) the status of energy conservation codes and standards for new buildings that have been implemented by states; (2) significant modifications states have been made to the model energy codes and standards they have adopted; and (3) preliminary evaluations of obstacles and/or requirements states may face in implementing the Building Energy Performance Standards (BEPS). Information presented in this report was collected through written correspondence and telephone conversations with representatives of state building code agencies and state energy agencies. The study identifies forty-six states, the District of Columbia, and four US Territories that have adopted some form of energy conservation code or standard. A complete matrix of energy codes adopted by states is given. (MC was produced in the run with catalyst. It is suggested that finer size coal particles and choice of a high-softening-point coal would alleviate the coking. 19 references.

3202 Transportation

REFER ALSO TO CITATION(S) 1828

2087 **Advisory Council on Energy Conservation, Paper 9. Civil aviation: energy considerations.** London, England; Department of Energy (1979). 33p. (NP—2900848). HMSO, 49 High Holborn, London, England £2.25.

The present traffic and oil consumption of UK civil aviation and forecasts to the end of the century are described. Some possibilities for fuel conservation are discussed. (MHR)

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 2081, 2094

2088 **(ANL—81-61) Status report on NASA electronic power-factor control technology and development.** Koehl, E.R. (Argonne National Lab., IL (USA)). Apr 1981. Contract W-31-109-ENG-38. 48p. NTIS, PC A03/MF A01. Order Number DE82000704.

This study was undertaken to evaluate the current status of the electronic, induction-motor, power-factor control, to identify the potential market of this device and the potential savings this device could produce in the United States energy economy. Included are a status report of the Interagency Agreement between NASA and DOE and the recommendations regarding future efforts of the DOE in the demonstration and commercialization of the power-factor control technology.

2089 **(ANL/EES-TM—150) Pulse-combustion technology for heating applications. Quarterly progress report, October 1-December 31, 1980.** Blomquist, C.A.; Clinch, J.M.; Egbert, H.P. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 34p. NTIS, PC A03/MF A01. Order Number DE82000050.

The primary purpose of the research program was to develop and expand the technology base for fossil-fuel-fired pulse combustion systems. A major goal of the program is to develop design data procedures for pulse combustion burners to accelerate industrial development of cost-effective, high-efficiency systems for heating applications. Progress is reported on Task 1, Gas-Fired-Combustor Technology. Fourteen experiments were conducted during this quarter. Four tests employed the standard pulse combustion burner; six, a corebuster inside the burner tailpipe; two, both the inlet and exhaust muffler installed; and two, a tailpipe aspirator. Operating conditions for these tests, for a previously reported test, and for an experiment conducted this quarter are tabulated. Heat transfer data obtained for the tests are presented. Progress on burner noise, flue gas CO and CO_2 content, and burner fundamental frequency tests is reported. (MCW)

2090 **(P—500-80-040) Feasibility of cogeneration energy supply for Oakland Airport terminal facilities.** Martineau, C. Jr. (Energy Systems Planning, Inc., Palo Alto, CA (USA)). May 1980. 94p. California Energy Resources Conservation and Development Commission, 111 Howe Avenue, Sacramento, CA 95825. Order Number DE82900597.

The feasibility of using a cogeneration system at the Oakland Airport Main Terminal to provide electric, heating, and cooling needs is evaluated. Both a reciprocating engine (Otto Cycle) or a combustion turbine (Brayton Cycle) were considered. Waste heat is used for space and water heating along with cooling from absorption chillers. Natural gas engine equipment is the most efficient and cost effective technology for this particular project and would provide 700 kW of electricity, and all of the heating and cooling energy needs. The plant will cost approximately $852,000 to construct, produce annual net operating revenues of approximately $194,000, have an internal rate of return of 19% and an estimated payback period of 4.4 years. This plant will conserve the energy equivalent of 161,000 gallons of oil per year. Atmospheric emissions can be sufficiently controlled with catalytic converters or water injection. Noise suppression would impose no practical restrictions. Several financing opportunities were considered, either revenue bonds or internal financing by the Port Authority would appear possible.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 1829

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3303 Electric-powered Systems

2091 **(DOE/CS/51213—T17) Near term electric vehicle program. Safety report.** (AiResearch Mfg. Co., Torrance, CA (USA)). 20 Mar 1979. Contract AC03-76CS51213. 20p. NTIS, PC A02/MF A01. Order Number DE81023635.

Safety has been an important requirement with the objective of identifying, controlling, and/or eliminating those hazards and failure modes that would result in substantial vehicle damage and/or injury or death to occupants during normal operation of the near term electric vehicle (NTEV). Specific requirements have been met through design or selection of available, certified automotive components. Analysis and tests are included in the vehicle development program to confirm that the car delivered to DOE is safe for extended evaluation. Safety considerations are divided into the following four areas, which are discussed in detail in subsequent sections. Federal Motor Vehicle Safety Standards: all applicable federal standards have been considered in the design of the vehicle. Each of the standards is discussed in detail; Power System: a failure mode and effects analysis has been conducted, which shows that potential hazards of the power system have been identified and controlled; Bodpredictions of the vehicle performances, characteristics, and losses of any future improvements or modificationult to develop and implement because they cannot be easily communicated to the public. Furthermore, it is likely that particular energy policies will be incorporated into one of the two major dimensions of attitudes and experience, both negative, and opposed accordingly. Policymakers face a challenging situation that could be alleviated only if voters develop a coherent, integrated body of thought on energy issues. 18 references, 4 tables, 5 notes.

2092 **(DOE/CS/51213—T18) Near-term electric vehicle program. Power system development test report.** (AiResearch Mfg. Co., Torrance, CA (USA)). 30 Aug 1979. Contract AC03-76CS51213. 215p. NTIS, PC A10/MF A01. Order Number DE81024243.

The Near-Term Electric Vehicle power system are presented. Component and system testing on breadboard equipment has demonstrated the feasibility of the unique battery-motor-flywheel propulsion system for the near-term electric vehicle (NTEV). These tests culminated in a number of acceleration/deceleration runs and driving cycles under both open- and closed-loop control

against a vehicle load on a dynamometer. A prime objective of the development program, in addition to operational demonstrations, was to obtain component loss data for verifying or altering, as required, the component loss equations used in the computer model of the system. The latest correlation between the computer model and the breadboard test system shows very close agreements between predicted vehicle and flywheel speed and actual speeds recorded during the runs. This correlation provides confidence in predictions of the vehicle performances, characteristics, and losses of any future improvements or modificationult to develop and implement because they cannot be easily communicated to the public. Furthermore, it is likely that particular energy policies will be incorporated into one of the two major dimensions of attitudes and experience, both negative, and opposed accordingly. Policymakers face a challenging situation that could be alleviated only if voters develop a coherent, integrated body of thought on energy issues. 18 references, 4 tables, 5 notes.

3305 Flywheel Propulsion

REFER ALSO TO CITATION(S) 2092

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 2091, 2136

2093 **Minimum weight design in double-layer panels: sheet molding compound versus steel.** Chang, D.C.; Barone, M.R. (General Motors Research Labs., Warren, MI). *American Society for Testing and Materials, Special Technical Publication;* 59-70(1979). (ASTM-STP—674; CONF-780347—).

From Symposium on composite materials: testing and design; New Orleans, LA, USA (20 Mar 1978).

This paper deals with the use of structural optimization techniques to achieve weight reduction in automotive panels made from sheet molding compound (SMC) and steel. Multiple stiffness criteria are imposed as performance requirements on the panels. Specifically, we consider the effect of changes in structural stiffness criteria as well as minimum gage and allowable depth constraints on the minimum weight design of double-layer panels. Both SMC and steel designs are compared.

36 MATERIALS

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 1721, 1811, 1826, 1876, 1902, 1903, 1937, 1937, 2003, 2005, 2007, 2008, 2016, 2017, 2033, 2034, 2056, 2232, 2254, 2291, 2654, 2963, 2984, 3123, 3123

2094 **(DOE/CS/40215—T4) Energy savings through the use of an improved aluminum reduction cell cathode. Progress report, June-July 1980.** (Kaiser Aluminum and Chemical Corp., Oakland, CA (USA)). 23 Aug 1979. Contract AC03-76CS40215. 5p. NTIS, PC A02/MF A01. Order Number DE81027008.

Kaiser restarted the 15-kA pilot scale cell with near vertical electrodes and operated it for 24 hours before anode stub failure forced a shutdown. Modelling of bubble motion and melt flow is discussed. Calculated values are given for the Morton and ACD numbers. (DLC)

2095 (INIS-mf—6528, pp 110-113) **Radiochemical study of the dissolution of iron.** Joo, P.; Konya, J.; Banhidi, O.; Kardos, M. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Izotop Lab.). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

With ^{55}Fe-^{59}Fe isotopes as tracers a radioactive indication method was used to investigate the electrochemical dissolution processes of metallic iron under the condition of galvanostatic anodic polarization (at the spontaneous potential in acidic solutions containing NO_3^-, Cl^- and Br^- anions in the absence of oxidizing agents). Only the kinetics was influenced by the anions via their specific adsorptions.

2096 (INIS-mf—6528, pp 154-158) **Corrosion tests of an industrial apparatus made of boiler steel plates Type KL-2.** Maleczki, E.; Hazi, E.; Faludi, G.. (Veszpremi Vegyipari Egyetem (Hungary). Radiokemiai Tanszek); Horvath, J. (Elemiszeripari Tervezoe Intezet, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The major structural material of multicompartment hydrostatical sterilizers used in the food-processing industries is a steel plate, Type KL-2. Its thickness varies between 4 and 12 mm. The elements of the apparatus in contact with water, steam and condensed water are subject to corrosion due to oxygen, carbon-dioxide and salts present in the system. A radiometric measurement technique has been used to determine the extent of corrosion in two such systems by measuring the wall-thickness. The protection provided by various inhibitor solutions were compared in a laboratory model experiment using activated steel plate samples.

2097 (INIS-mf—6528, pp 247-250) **Examination of a dual-step conversion layer by radioactive tracers.** Varga, I.; Badacsonyi, T.; Maleczki, E. (Veszpremi Vegyipari Egyetem (Hungary). Radiokemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Radioactive tracers, ^{32}P and ^{51}Cr have been used to examine the formation of a dual conversion layer on the surface of aluminium samples. For layer formation so-called green and yellow chromate solutions were used. It could be concluded that the mechanism of the yellow chromate solution was the same in the case of both the pure aluminium samples and the samples partly covered in the green chromate solution. The optimum heating parameters have been determined for both solutions.

2098 (INIS-mf—6542, pp vp) **Microwave propagation in simple metals and Fermi-liquid effects.** Vagner, I.D. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2099 (INIS-mf—6542, pp vp) **Self diffusion parameters in fcc metals.** Kornblit, L. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2100 (INIS-mf—6542, pp vp) **Antiferrodistortive and ferromagnetic interactions between Cu^{2+} ions in CaO. EPR study.** Barak, J.; Englman, R.; Raizman, A.; Suss, J.T. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2101 (INIS-mf—6542, pp vp) **Probable electronic transition in K_2Cs compound at low temperature.** Steinberg, V.; Voronel, A.; Sverbilova, T.; Peretsman, L. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2102 (INIS-mf—6542, pp vp) **2-D to 3-D percolation transition in Pb-Ge films.** Deutsch, G.; Rappaport, M.L. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2103 (INIS-mf—6542, pp vp) **Phonon-drag contribution to the electrical resistivity of polyvalent metals. Aluminium.** Brody, M.; Kaveh, M.; Wiser, N. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2104 (INIS-mf—6542, pp vp) **Effect of annealing on the temperature dependence of the electrical resistivity of aluminium.** Sinvani, M.; Greenfield, A.J. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2105 (INIS-mf—6542, pp vp) **Isothermal annealing of a dilute gold-erbium alloy.** Raizman, A.; Suss, J.T. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center); Seidman, D.N. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering); Shaltiel, D.; Zevin, V. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2106 (INIS-mf—6542, pp vp) **Crystallization of amorphous Dy-Fe thin films.** Shikhmanter, L.; Talianker, M. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)); Dariel, M.P. (Ben-Gurion Univ. of the Negev, Beersheba (Israel); Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2107 (INIS-mf—6542, pp vp) **Effect of substrate temperature on percolation threshold of co-evaporated Ae-Ge films.** Kapitulnik, A.; Rappaport, M.L.; Deutscher, G. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2108 (INIS-mf—6542, pp vp) **Dimensional effects on I-V characteristics of Pb-Ge superconducting microbridges.** Palevsky, A.; Deutscher, G.; Rappaport, M.L. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2109 (INIS-mf—6542, pp vp) **Sputtered hydrogenated amorphous Si alloyed with Al.** Dayan, M.; Croitoru, N.; Lereah, Y. (Tel Aviv Univ. (Israel). Dept. of Engineering Sciences). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2110 **Microslip-induced degradation in a braided superconductor.** Tsukamoto, O.; Maeda, H.; Iwasa, Y. (Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Applied Physics Letters;* **39**: No. 11, 918-920(1 Dec 1981).

Based on results of two quite different experiments, we report microslip-induced degraded performance of a braided superconductor. Microslips, or more formally, microscopic slips, are inherent in all sliding events and are quite different from the well-known stick slips that occur, on a macroscopic scale, for "unstable" sliding pairs. Microslips occur universally in all material pairs. Their effects are, in general, innocuous except in low-temperature situations such as those found in superconducting magnet windings. Because materials have extremely low-heat capacities at 4.2 K, the miniscule amount of energy released by a microslip can precipitate a quench in the superconducting magnets.

2111 **Polymorphic transitions in single crystals: A new molecular dynamics method.** Parrinello, M.; Rahman, A. (University of Trieste, Trieste, Italy). *Journal of Applied Physics;* **52**: No. 12, 7182-7190(Dec 1981).

A new Lagrangian formulation is introduced. It can be used to make molecular dynamics (MD) calculations on systems under the most general, externally applied, conditions of stress. In this formulation the MD cell shape and size can change according to dynamical equations given by this Lagrangian. This new MD technique is well suited to the study of structural transformations in solids under external stress and at finite temperature. As an example of the use of this technique we show how a single crystal of Ni behaves under uniform uniaxial compressive and tensile loads. This work confirms some of the results of static (i.e., zero temperature) calculations reported in the literature. We also show that some results regarding the stress-strain relation obtained by static calculations are invalid at finite temperature. We find that, under compressive loading, our model of Ni shows a bifurcation in its stress-strain relation; this bifurcation provides a link in configuration space between cubic and hexagonal close packing. It is suggested that such a transformation could perhaps be observed experimentally under extreme conditions of shock.

2112 **Ab initio calculation of the static structural properties of Al.** Lam, P.K.; Cohen, M.L. (Department of Physics, University of California at Berkeley, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **24**: No. 8, 4224-4229(15 Oct 1981).

The static structural properties of Al are calculated using the self-consistent pseudopotential approach with local-density functional expressions for the exchange and correlation energies. The only input parameter is the atomic number. Calculated values for the lattice constant, bulk modulus, and cohesive energy agree with experimental values within $<1\%$, $\sim 1\%$, and $\sim 7\%$, respectively.

2113 **Kinetics of hydrogen absorption-desorption by niobium.** Pick, M.A. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **24**: No. 8, 4287-4294(15 Oct 1981).

The kinetics of hydrogen absorption and desorption by clean, recrystallized Nb foils, (110) orientation, were measured as a function of temperature. The results are discussed on the basis of a previously published model for the kinetics. It was found that, contrary to the original assumption, the initial sticking coefficient of hydrogen on the clean Nb(110) surface is temperature dependent and can be described by the expression S/sub i/ = S_0 e[-(2E/sub I//RT)], where S_0 was found to be close to unity and E/sub I/ = (1.27 +- 0.01) kcal/mol H. This led to a modification of the theoretical model by the inclusion of an activation energy for chemisorption. Furthermore, an analysis of the temperature-dependent data yielded values for the chemisorption energy of hydrogen E/sub D/ = (14.8 +- 0.2) kcal/mol H, the vibrational entropy at the surface, the surface coverage, as well as other parameters related to the energy barrier at the surface.

2114 **Surface states, surface magnetization, and electron spin polarization: Fe(001).** Wang, C.S.; Freeman, A.J. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] B: Condensed Matter;* **24**: No. 8, 4364-4371(15 Oct 1981).

Results are presented of an ab initio self-consistent spin-polarized energy-band study of a 7-layer ferromagnetic Fe(001) film to determine the energy dispersion and spatial character of surface states and their effects on the surface spin polarization, surface magnetic moment, and average exchange splitting. Band structures and surface states, layer density of states, and charge and spin densities are presented and used to discuss the surface effects in the interpretation of a number of experiments. A substantial enhancement of the surface-layer magnetic spin moment from its bulk value is found on Fe(001), which is in sharp contrast to the 20% reduction reported in our earlier study of a 9-layer Ni(001) film. Both of these results are consistent with available experimental information.

2115 **Optical structure near 20 meV in valence-fluctuation compounds.** Pinkerton, F.E.; Sievers, A.J.; Wilkins, J.W.; Maple, M.B.; Sales, B.C. (Materials Science Center and Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). *Physical Review Letters;* **47**: No. 14, 1018-1022(5 Oct 1981).

The first measurement is reported of low-energy (20 meV) structure in the low-temperature dielectric function of two valence-fluctuation materials: $CePd_3$ and $YbCu_2Si_2$. The structure is consistent with energy-dependent scattering of electrons off a resonant level whose width and position (relative to the Fermi level) are roughly comparable. No such structure is observed in the integral valent materials YPd_3, $DyPd_3$, and $LuCu_2Si_2$. The valence-fluctuation compounds $CeCu_2Si_2$ and $CeAl_3$ do not show a resonance above 4 meV.

2116 **Moessbauer-effect study of iron-boron-beryllium metallic glasses.** Lin, M.C.; Severin, C.S.; Barnes, R.G.; Chen, C.W. (Ames Laboratory-U. S. Department of Energy and Departments of Physics and Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **24**: No. 7, 3719-3728(1 Oct 1981).

^{57}Fe Moessbauer spectra have been obtained at both liquid-nitrogen and room temperatures for a series of metallic glasses Fe$_{82}$B/sub 18-x/Be/sub x/ with 0< or =x< or =6. With the use of Window's program the spectra were fitted and deconvoluted to obtain the probability distribution function of the effective magnetic hyperfine field P(H), and the results show a well-defined symmetric shape for these metallic glasses. The width of P(H), ΔH, remains approximately constant at a value of 80 kOe for all samples. However the most probable value of the effective magnetic hyperfine field H_1 at liquid-nitrogen temperature initially increases with the Be content to 4 at. %, but starts to decrease as x exceeds 4. The isomer shift has a value of -0.032 mm/sec for samples with x< or =4 but changes to -0.050 mm/sec for samples with x>4. The crystallization products obtained upon annealing the $Fe_{82}B_{18}$ metallic glass at T/sub a/ = 420 °C were identified as tetragonal Fe_3B and α-Fe. The annealing of the samples with x>0 between T/sub x/1 and T/sub x/2 yields a metastable amorphous phase and crystalline solid solutions of an Fe-Be phase. Annealing of the samples with x>0 above T/sub x/2 yields crystalline Fe-Be solid solutions and the Fe_3B intermetallic compound. The intensity ratios in the Moessbauer spectra clearly indicate that annealing of samples between T/sub x/1 and T/sub x/2 led to the alignment of the H-bar/sub eff/ direction close to the ribbon plane, but annealing above T/sub x/2 left H-bar/sub eff/ randomly oriented.

2117 **Specific-heat studies of neutron-irradiated A15 Nb_3Al.** Cort, B.; Stewart, G.R.; Snead, C.L. Jr.; Sweedler, A.R.; Moehlecke, S. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Physical Review [Section] B: Condensed Matter;* **24**: No. 7, 3794-3799(1 Oct 1981).

The specific heat of neutron-irradiated Nb_3Al has been measured in the temperature range 1.3—25 K for fluences of 1.3×10^{18} and 1.3×10^{19} n/cm^2 (E>1 MeV). A reduction in the superconducting transition temperature is accompanied by an increase in transition width with increasing fluence. The Debye temperature increases 20%, and the electronic density of states shows a slight decrease that is within error limits, relative to the unirradiated material.

2118 **Specific heat of A 15 Nb_3Sn in fields to 18 tesla.** Stewart, G.R.; Cort, B.; Webb, G.W. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **24**: No. 7, 3841-3846(1 Oct 1981).

For the first time, the low-temperature specific heat of A 15 Nb_3Sn has been measured in a magnetic field (18 T) high enough to significantly suppress the superconducting transition temperature, T/sub c/. All previous extrapolations to T = 0 of the normal-state specific heat, C/sub n/, to determine γ and N(0) are shown by the measured C/sub n/ data to be incorrect. The Debye temperature, O/sub D/, has previously been assumed to vary smoothly with temperature from its low-temperature value [θ/sub D/ (T<4 K) = 208 K] to its higher-temperature value [θ/sub D/(T>T/sub c/) = 270 K]. The high-field measurement of θ/sub D/(T) shows that it remains constant upon cooling until 11 K, where it abruptly changes to its low-temperature value. The rather short extrapolation of the high-field normal-state data to T = 0 from T>T/sub c/ (18 T) yields a γ of 35 +- 3 mJ/mole K^2 compared to the previously accepted value of 52 mJ/mole K^2. Using this lower value for γ, and taking λ = 1.75 from tunneling results, implies N(0) = 1.35 +- 0.1 states/eV atom in excellent agreement with recent band-structure calculations of Klein et al. who obtained 1.46 states/eV atom for A15 Nb_3Sn. The present work calls into question all other extrapolations of C/sub n/ data in high-T/sub c/ materials where Θ/sub D/ is known to change significantly between T/sub c/ and 0 K, e.g., A15 V_3Si.

2119 **Magnetic form factor of metallic iron and nickel as seen by inelastic neutron scattering from phonons.** Steinsvoll, O.; Moon, R.M.; Koehler, W.C.; Windsor, C.G. (Institutt for Atomenergi, Kjeller, Norway). *Physical Review [Section] B: Condensed Matter;* **24**: No. 7, 4031-4040(1 Oct 1981).

The magnetic form factors of iron and nickel have been studied by means of coherent inelastic vibrational scattering of polarized neutrons in high-symmetry directions for momentum transfers which are different from the reciprocal-lattice vectors. The vibrational scattering has been separated from other inelastic scattering processes, such as spin-wave scattering, by means of energy analysis on a triple-axis polarized-neutron spectrometer. In the case of iron we see definite departures from the interpolated elastic form factor, depending on the direction and magnitude of the scattering vector. In the case of nickel the inelastic form factor is identical, within experimental error, to the elastic form factor.

2120 **Internal friction and elastic softening in polycrystalline Nb_3Sn.** Bussiere, J.F.; Faucher, B.; Snead, C.L. Jr.; Welch, D.O. (Institut de genie des materiaux, CNRC, 750 Bel-Air, Montreal, Canada H4C 2K3). *Physical Review [Section] B: Condensed Matter;* **24**: No. 7, 4087-4090(1 Oct 1981).

The vibrating-reed technique was used to measure internal friction and Young's modulus of polycrystalline Nb_3Sn in the form of composite Nb/Nb_3Sn tapes from 6 to 300 K. In tapes with only small residual strain in the A15 layers, a dramatic increase in internal friction with decreasing temperature is observed with an abrupt onset at ~48 K. The internal friction Q^{-1} between 6 and 48 K is believed to be associated with stress-induced motion of martensitic-domain walls. In this temperature range, Q^{-1} is approximately proportional to the square of the tetragonal strain of the martensitic phase; $Q^{-1}\alpha$ (c/a-1)^2. With residual compressive strains of ~0.2%, the internal friction associated with domain-wall motion is considerably reduced. This is attributed to a biasing of domain-wall orientation with residual stress, which reduces wall motion induced by the (much smaller) applied stress. The transformation temperature, however, is unchanged (within +- 1 K) by residual strains of up to 0.2%. Young's modulus exhibits substantial softening on cooling from 300 to 6 K. This softening, is substantially reduced in the presence of small residual compressive strains, indicating a highly nonlinear stress-strain relationship as previously reported for V_3Si.

2121 **Oxygen induced dissolution and segregation of silicon in platinum single crystals.** Salmeron, M.; Somorjai, G.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology;* **19**: No. 3, 722-725(Sep 1981).

The segregation of silicon in platinum flat (111), stepped (553) and (332) surfaces is studied as a function of crystal temperature. Silicon segregates below 1000°C with a segregation energy between 17 and 20 kcal/mol. In the retarding field mode, the maximum amount of segregated Si corresponds to a Si (93 eV)/Pt (242 eV) Auger peak ratio of about 5. In the presence of O_2, Si dissolves into the bulk at T> or ≈600°C. The rate of Si dissolution increases with O_2 pressure and crystal temperatures. At an O_2 pressure of 5×10^{-7} Torr, the activation energy for the dissolution process is 16 +- 2 kcal/mol. Continued exposure to O_2 results in the reappearance of Si at the Pt surface as a new phase, SiO/sub x/, characterized by Auger peaks of Si (84 eV) and O (515 eV).

2122 Infrared hole-burning spectroscopy of matrix-isolated ReO_4-molecules. Chraplyvy, A.R.; Moerner, W.E.; Sievers, A.J. (Physics Department, General Motors Research Laboratories, Warren, Michigan 48090). *Optics Letters;* **6**: No. 9, 431-433(Sep 1981).

CO_2-laser-diode-laser hole-burning spectroscopy has been used to measure the temperature-dependent homogeneous linewidth of the ReO_4- infrared active internal-vibrational mode (ν_3) in alkali halide lattices. Hole widths as small as 20 MHz (FWHM) have been observed in an inhomogeneously broadened line width as large as 1 cm^{-1}. Our measurement of the homogeneous linewidth over 4 orders of magnitude indicates that elastic acoustic phonon scattering is the dominant T_2 relaxation process from 10 to 600 K.

2123 Proximity electron tunneling spectroscopy. IV. Electron-phonon coupling and superconductivity of tantalum. Wolf, E.L.; Burnell, D.M.; Khim, Z.G.; Noer, R.J. (Ames Laboratory-USDOE and Department of Physics, Iowa State University, Ames, Iowa). *Journal of Low Temperature Physics;* **44**: No. 1, 89-118(1 Jul 1981).

An extensive superconducting electron tunneling study of Ta using both a proximity method and an optimized conventional spectroscopy, is reported. The results for Ta confirm the electron-phonon origin of superconductivity in this element, and provide slightly improved superconducting parameters: $\lambda = 0.73$ and $\mu ph = 0.11$. The results from the PET and optimized conventional methods are in substantial agreement, although the proximity method appears to provide somewhat better resolution of structure in the Eliashberg function $\alpha^2F(E)$.

2124 Optical phonons and crystalline symmetry of InSe. Carlone, C.; Jandl, S. (Sherbrooke Univ., Quebec (Canada). Dept. de Physique); Shanks, H.R. (Ames Lab., IA (USA)). *Physica Status Solidi [Sectio] B: Basic Research;* **103**: No. 1, 123-130(1 Jan 1981).

A survey of the Raman and infrared data for the layered structure InSe shows that there is no agreement upon its crystallographic structure. The polytypes β, eta, and γ are equally invoked by the various groups. Some experiments on samples from different laboratories are repeated. Infrared transmission at different temperatures and Raman spectra away from resonance are obtained. It is concluded on the basis of the optical data that InSe crystallizes only in the β-polytype. All previous optical measurements can be explained with the β-polytype if one takes into account the resonance Raman effect. It is inferred from the Raman and infrared data that the interlayer interaction cannot be exclusively of the van der Waals type and that long range Coulomb forces contribute to the lattice dynamics of InSe.

2125 ^{166}Er and ^{119}Sn Moessbauer studies of the re-entrant ternary superconductors ErRhsub(1.1)Snsub(3.6). Shenoy, G.K. (Argonne National Lab., IL (USA)); Technische Univ. Muenchen (Germany, F.R.)); Proebst, F. (Technische Univ. Muenchen (Germany, F.R.)); Cashion, J.D.; Viccaro, P.J.; Niarchos, D.; Dunlap, B.D. (Argonne National Lab., IL (USA)); Remeika, J.P. (Bell Labs., Murray Hill, NJ (USA)). *Solid State Communications;* **37**: No. 1, 53-55(Jan 1981).

Moessbauer effect measurements have been carried out using ^{166}Er and ^{119}Sn in the re-entrant ternary superconductor ErRhsub(1.1)Snsub(3.6). The Er moment at 0.26 K is found to be 7.6 +- 0.2 sub(μB). At 4.2 K the ground state doublet is predominantly occupied with g(parallel) = 15.7 +- 0.1 and g(perpendicular) = 1.77 +- 0.15. The ^{119}Sn resonance reveals two chemically inequivalent sites in this compound and the 1.5 K spectrum shows the presence of a spin density.

2126 Nondestructive quality control of sintered refractory metal products. Viplava Kumar, J.; Ramesh, K.; Ghude, S.H. (Mishra Dhatu Nigam Ltd., Hyderabad (India)). pp 481-487 of Proceedings of the symposium on sintering and sintered products [held at] Bombay, October 29-31, 1979. Bombay, India; Department of Atomic Energy (1980).

From Symposium on sintering and sintered products; Bombay, India (29 Oct 1979).

Nondestructuve testing of P/M products is a promising field. Besides defectoscopy, the advantage of nondestructive measurements in porous media lies in a rapid and accurate evaluation of physical and mechanical properties, such as point-to-point porosity, degree of interparticle metallic contact, modulus of elasticity, ultimate tensile strength and anisotropy. On the basis of inline experimental results obtained on tungsten and molybdenum products, a working system of quality control has been evolved at Mishra Dhatu Nigam Limited, Hyderabad.

2127 Effect of grain size and cold working on high temperature strength of Hastelloy X. Fujioka, J.; Murase, H.; Matsuda, S. (Kawasaki Heavy Industries Ltd., Akashi, Hyogo (Japan). Technical Inst.). pp 197-203 of Fourth international conference on pressure vessel technology. Volume 1. Materials, fracture and fatigue. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

Effect of grain size and cold working on creep, creep rupture, low cycle fatigue and tensile strengths of Hastelloy X were studied at temperatures ranging from 800 to 1000°C. In order to apply these data to design, the allowable design stresses were estimated by expanding the criteria of ASME Code Case 1592 to such a high temperature range. The allowable design stress increased, on the other hand, the low cycle fatigue life decreased with increasing grain size. Cold working up to a ratio of 5 per cent may not be a serious problem in design, because the allowable design stress and the fatigue life were little affected. The cause of these variations in strength was discussed by examining the initiation and growth of cracks, and the microstructures.

2128 Formation and migration properties of the rare gases He, Ne, Ar, Ke, and Xe in nickel. Melius, C.F.; Wilson, W.D.; Bisson, C.L. (Sandia Labs., Livermore, CA (USA)). *Radiation Effects;* **53**: No. 3/4, 111-120(1980).

From Symposium on rare gases in metals and alkali halides; Harwell, UK (10 - 14 Sep 1979).

The energies of formation and migration of various rare gas-point defect complexes in an f.c.c. nickel lattice have been calculated for He, Ne, Ar, Kr, and Xe. Formation energies of rare gas atoms at interstitial sites are compared with those in substitutional sites. Binding energies are presented for self-interstitials and vacancies trapped to the various rare gas substitutionals. Migration energies and migration paths are also presented for various rare gas interstitials and substitutionals with and without trapped vacancies and self-interstitials. The migration energies are compared with the breakup energies for the corresponding complexes. It is found that divacancy-rare gas complexes are rather stable and will migrate at relatively low energies compared to other substitutional rare gas migration processes.

2129 Sputter ion plating. Coad, J.P.; Dugdale, R.A. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). pp 186-196 of IPAT 79. Proceedings of the international conference on ion plating and allied techniques. Edinburgh, England; CEP Consultants Ltd. (1979).

From International conference on ion plating and allied technology; London, UK (Jul 1979).

The method, as at present developed, employs a simple DC glow discharge in argon to transfer material from appropriate cathodes by the action of ion bombardment to substrates suitably mounted within the soft vacuum chamber. The chamber itself, or a liner within it, is arranged to operate at elevated temperature, eg 200°C or more, and the connection to the pump is designed to prevent back diffusion of contaminating gases and vapours. Cathodes may be distributed in sheet form, or other geometry as required, to give high throwing power and a high degree of coating uniformity; rotation or movement of substrates is not normally needed. In addition to direct sputtering of compound cathodes, chemically active gases may be admitted in controlled concentration to deposit compounds by reactive sputtering. Coating rates at present lie in the range 0.5 to 5μm/hr. A negative bias is applied to the substrates for ion cleaning and subsequent control of coating structure during deposition.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 2115

2130 (INIS-mf—6542, pp vp) **Crossover from first-order to continuous transition induced by symmetry-breaking fields.** Kerszberg, M.; Mukamel, D. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2131 **Magnetic properties of the reentrant ferromagnetic superconductor $HoMo_6S_8$.** Lynn, J.W.; Shirane, G.; Thomlinson, W.; Shelton, R.N.; Moncton, D.E. (Department of Physics and Institute for Physical Science and Technology, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] B: Condensed Matter;* **24**: No. 7, 3817-3829(1 Oct 1981).

Neutron diffraction and ac susceptibility techniques have been used to study the magnetic and superconducting phase transitions in the ternary Chevrel phase system $HoMo_6S_8$. The material first becomes superconducting at T/sub c/1 = 1.82 K. With further decrease of temperature ferromagnetic correlations develop, with a correlation range in real space which increases with decreasing temperature. On further cooling, a long-wavelength (~230 A) oscillatory magnetic state forms (T/sub os/ = 0.71 K) in the superconducting phase, with a wavelength which increases with the application of a magnetic field. At still lower temperatures the superconductivity is destroyed (T/sub c/2/sup(C/) = 0.612 K) as long-range ferromagnetic order sets in. The ferromagnetic phase at low temperatures is characterized by a saturated magnetic moment μ/sub z/ = 9.06 +- 0.3 μ/sub B/, with the spins directed along the unique [111] trigonal axis. When the material is warmed from the ferromagnetic state, no oscillatory magnetic phase appears to form, with the system passing directly from ferromagnetism to superconductivity at T/sub c/2/sup(W/) = 0.668 K.

2132 **Thermodynamic calculation of the phase diagram of the UC-UN system.** Udovskii, A.L.; Ivanov, O.S. (AN SSSR, Moscow. Inst. Metallurgii). pp 229-246 of Thermodynamics of nuclear materials 1979. Vol. 2. Proceedings of an international symposium held by the IAEA in Juelich, Federal Republic of Germany, from 29 January to 2 February 1979. Vienna, Austria; IAEA (1980). (In Russian)

From International symposium on thermodynamics of nuclear materials; Julich, F.R. Germany (29 Jan 1979).

In this paper the authors put forward a new version of the phase diagram for the UC-UN section that they obtain by thermodynamic calculation using the regular-solution approximation and taking into consideration the maximum melting point and the enthalpy of mixing of experimentally obtained uranium carbonitride solid solutions. The results of the calculation agree satisfactorily with experimental data on the melting points of uranium carbonitrides. More particularly, the calculated alloy composition corresponding to the maximum melting point is 0.6905, which is in good agreement with the experimental value of xsub(m)=0.7. The analysis of the experimental concentration relationships between the adiabatic modulus of elasticity, shear modulus and Debye temperature of the uranium carbonitride solid solutions indicates, in accordance with the Lindemann relationship, the existence of a maximum melting point in the region of compositions with x=0.75-0.80 molar fractions of UN. The authors also describe a method of calculating the thermodynamic parameters using a regular-solution model from experimental phase diagrams for two-component systems. This method is applicable to the bcc solid-liquid system phase equilibrium in the U-Pu system.

2133 **Calculation of neutron structural multipliers for zirconium hydride in the epsilon phase.** Mandzhavidze, A.G.; Kolesnikov, Yu.M.; Gogava, V.V.; Fedorov, V.M. pp 130-133 of Ehlektronnye i ionnye protsessy v tverdykh telakh. Radiatsionno-termicheskie izmeneniya struktury kristallicheskoj reshetki. Tbilisi, USSR; Metsniereba (1979). (In Russian)

The model of low-temperature phase transformations of zirconium hydride connected with appearance of the ordered distribution of hydrogen and hydrogen vacancies is considered. Calculations of the structural multipliers for the model which in case of the ZrH stoichiometric relation has the symmetry of the zirconium sublattice with doubled parameters are given. The theoretical and experimental data are compared. The ZrH investigations have shown that at room temperature approximately 13% of hydrogen atoms are in octahedral, and the rest 87% are in tetrahedral interstices. It is shown that at the 4.2 K temperature the atoms of hydrogen and hydrogen vacancies are ordered.

3603 Composite Materials

2134 **Lifetime predictions for polymers and composites under constant load.** Christensen, R.M. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Journal of Rheology;* **25**: No. 5, 517-528(Oct 1981).

A method is derived for estimating the lifetime of engineering polymers and composites acted upon by steady loads. The method applies a recently developed theory of crack growth in polymers. The basic properties that enter the analysis are the viscoelastic creep function of the material and the energy content of the crack-generated surface layer. In addition, the characteristic (failure) dimension of the body must be specified, together with the load (stress) level acting upon the body and a stress-distribution parameter. The final result of the derivation is a single, simple formula that expresses time to failure as a function of the input parameters. The method has been compared with experimental data upon arimid composite-material strands, with encouraging results. The resulting predictions are fundamentally different from those of the Zhurkov formula, which is based upon an activation-energy characterization for molecular schism. The model has been cast into a statistical form to accommodate a realistic treatment of data having wide scatter.

2135 **Composite materials: testing and design (fifth conference).** Tsai, S.W. (ed.). Philadelphia, PA; American Society for Testing and Materials (1979). 697p. (ASTM-STP—674; CONF-780347—). American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103 $52.50.

From Symposium on composite materials: testing and design; New Orleans, LA, USA (20 Mar 1978).

This volume consists of 38 papers that were presented at this conference. They are divided into seven sections dealing with: applications, design and data, testing and evaluation, environmental effects, fatigue, physicochemical properties, and mechanisms of failure. A summary of the conference and an index are also provided. Separate abstracts were prepared for two papers; two other papers had previously been processed for the data base. (DLC)

2136 **Effects of fiber length on elastic moduli of randomly-oriented chopped-fiber composites.** Weng, G.J.; Sun, C.T. (General Motors Research Labs., Warren, MI). *American Society for Testing and Materials, Special Technical Publication;* 149-162(1979). (ASTM-STP—674; CONF-780347—).

From Symposium on composite materials: testing and design; New Orleans, LA, USA (20 Mar 1978).

Based on a composite-cylinder model with a short cylindrical fiber embedded in the center of a cylindrical matrix, the longitudinal Young's modulus and major Poisson's ratio of a unidirectional, short-fiber composite are found in terms of the fiber volume fraction and the tip-to-tip spacing of the fibers. The expressions obtained are then modified to account for the influence of volume fraction and aspect ratio of the fibers. These results, together with Christensen and Waals' normalized expressions, are used to calculate the Young's modulus and Poisson's ratio of a randomly-oriented chopped-fiber composite in terms of the fiber volume fraction and its aspect ratio. The theory developed is then applied to examine numerically the effects of fiber length on the Young's modulus and Poisson's ratio of short glassfiber/polyester-resin composites. The results show that the Young's modulus of both unidirectional and randomly-oriented fiber composites are strongly dependent on the fiber length; so is the Poisson's ratio, though to a lesser degree.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 2134

2137 (IA—1356, pp 309-310) **Residence time distribution of PVC powder in a double-screw plastic extruder.** Lewis, S.; Lavi, N. Apr 1980. Dep. NTIS (US Sales Only).
In Research laboratories annual report 1978 and 1979.

2138 (INIS-mf—6542, pp vp) **Electrical conduction in doped polymers.** Shapira, M.; Schlesinger, Y.; Halpern, V; Baumel, S. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2139 **Investigations of static properties of two-dimensional bulk polymer systems.** Bishop, M.; Ceperley, D.; Frisch, H.L.; Kalos, M.H. (Division of Science and Mathematics, Fordham University at Lincoln Center, New York, New York 10023). *Journal of Chemical Physics;* **75**: No. 11, 5538-5542(1 Dec 1981).
The static properties of two dimensional excluded volume continuum multichain systems are investigated by a "reptation" Monte Carlo algorithm. All beads interact via a repulsive (shifted) Lennard-Jones potential. In addition, nearest neighbors along chains are linked by a quasiharmonic potential which permits limited pair extensions. Chain lengths of 5, 10, 20, 32, 50, and 70 beads have been studied. Studies at densities of 0.1, 0.3, and 0.5 demonstrate that chain dimensions are compressed as the concentration is increased. Both the mean square end-to-end distance $<R>$, and the mean square radius of gyration $<S^2>$ have a power law dependence upon l-1, the number of bonds, with exponent approximately 1.44 for rho = 0.1, 1.33 for rho = 0.3, and 1.20 for rho = 0.5. The asphericity ratios indicate the extent of compression as the density is increased. In addition, nonexcluded volume chains are studied via straightforward Monte Carlo integration. $<R^2>$ and $<S^2>$ have a power law dependence upon l-1 with exponent 1.00.

2140 **Study of domain structure in linear and crosslinked polyurethanes using pulsed proton NMR.** Assink, R.A. (Sandia National Labs., Albuquerque, NM); Wilkes, G.L. *Journal of Applied Polymer Science;* **26**: No. 11, 3689-3698(Nov 1981). Contract AC04-76DP00789.
Pulsed proton magnetic resonance was used to study the domain structure of a series of polyurethanes which had been crosslinked to various degrees at 210°C. The difference between segmental mobility of the hard and soft phases decreases with crosslinking. The fraction of rigid segments in the linear material decreases in two distinct stages as the temperature increases, while the fraction of rigid segments in the crosslinked material decreases in a continuous fashion as the temperature increases. Crosslinking also decreases the rate of domain formation following thermal treatment. These effects are attributed to the inability of the segments in the crosslinked material to completely segregate into domains.

2141 **Residual-strength determination in polymetric materials.** Christensen, R.M. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Journal of Rheology;* **25**: No. 5, 529-536(Oct 1981).
Kinetic theory of crack growth is used to predict the residual strength of polymetric materials acted upon by a previous history. Specifically, the kinetic theory is used to characterize the state of growing damage that occurs under a constant-stress (load) state. The load is removed before failure under creep-rupture conditions, and the residual instantaneous strength is determined from the theory by taking account of the damage accumulation under the preceding constant-load history. The rate of change of residual strength is found to be strongest when the duration of the preceding load history is near the ultimate lifetime under that condition. Physical explanations for this effect are given, as are numerical examples. Also, the theoretical prediction is compared with experimental data.

3606 Other Materials

REFER ALSO TO CITATION(S) 2130, 2191, 2222, 2223, 2255, 2679

2142 (INIS-mf—6542, pp vp) **Dislocation-induced flicker noise in silicon.** Mil'shtein, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2143 (INIS-mf—6542, pp vp) **Schottky barrier effects on the electrical properties of the Bi-NbO_2-Bi system.** Lalevic, B.; Gvishi, M.; Shoga, M. (Rutgers--the State Univ., New Brunswick, NJ (USA)). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2144 (INIS-mf—6542, pp vp) **Microwave conductivity along the single dislocation in semi-conductors.** Mil'shtein, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2145 (INIS-mf—6542, pp vp) **New method for precise determination of small changes of Moessbauer lines.** Ratner, E.; Ron, M. (Technion-Israel Inst. of Tech., Haifa. Dept. of Materials Engineering). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2146 (INIS-mf—6542, pp vp) **Neutron diffraction study of the deuterium occupancy in $Y_3Fe_5Osub(0.5)Dsub(x)$.** Pinto, H.; Gurewitz, E.; Dariel, M.P.; Shaked, H. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2147 (INIS-mf—6542, pp vp) **Commensurate-incommensurate transition in an adsorbed layer.** Azbel, M.Y. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2148 (INIS-mf—6542, pp vp) **Renormalization group approach to the magnetic phase transition in solid ^3He.** Shnidman, Y.; Mukamel, D. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2149 (INIS-mf—6542, pp vp) **Thermodynamic stability and phase transitions in systems with a chemical reaction.** Gitterman, M. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics); Steinberg, V. (Tel Aviv Univ. (Israel:. Dept. of Physics:. 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2150 (INIS-mf—6542, pp vp) **Photoresponse measurements as a tool for evaluating Cd-chalcogenide-based photoelectrochemical systems.** Mirovsky, Y.; Cahen, D.; Hodes, G.; Manassen, J.; Tenne, R. (Weizmann Inst. of Science, Rehovoth (Israel)). 1980. Dep. NTIS (US Sales Only).
From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2151 (INIS-mf—6542, pp vp) **Variation of the optical properties of amorphous silicon during crystallization.** Janai, M. (Technion-Israel Inst. of Tech., Haifa). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2152 (INIS-mf—6542, pp vp) **Properties of amorphous silicon films prepared by CVD of SiF_2.** Janai, N.; Weil, R.B.; Levin, K.; Pratt, B. (Technion-Israel Inst. of Tech., Haifa). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2153 (INIS-mf—6542, pp vp) **Evaluation of thin films over-etching in microelectronics.** Peled, A.; Haspel, M. (Elta, Electronics, Ashdod). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2154 (INIS-mf—6542, pp vp) **Infra-red optical fibers.** Arieli, R.; Katzir, A. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2155 **Melting phenomena and pulsed-laser annealing in semiconductors.** Narayan, J.; Fletcher, J.; White, C.W.; Christie, W.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Journal of Applied Physics;* **52**: No. 12, 7121-7128(Dec 1981).

Annealing of displacement damage (amorphous as well as layers containing only dislocation loops), dissolution of boron precipitates, broadening of dopant profiles, and the formation of constitutional supercooling cells have been studied in laser annealed silicon. These samples were irradiated with laser pulses (λ = 0.485 μm, E = 0.7—1.25 J cm^{-2}, tau = 9 ns), the same as those used by Compaan and coworkers for Raman temperature measurements. In contrast to their conclusion, present results can be interpreted only on the basis of a melting model.

2156 **Electric field enhanced emission from non-Coulombic traps in semiconductors.** Martin, P.A.; Streetman, B.G.; Hess, K. (Coordinated Science Laboratory and Department of Electrical Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Journal of Applied Physics;* **52**: No. 12, 7409-7415(Dec 1981).

Electric field enhancement of emission from three non-Coulombic traps has been calculated: the shielded Coulombic potential, the polarization potential, and the dipole potential. Both the Poole-Frenkel effect and phonon-assisted tunneling have been included, and both were found to be important. The field effect can be used to distinguish between these potentials on the basis of their long range character. This effect is most important in interpreting the results of capacitance transient studies of deep levels.

2157 **10—30-eV optical properties of GaN.** Olson, C.G.; Lynch, D.W.; Zehe, A. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **24**: No. 8, 4629-4633(15 Oct 1981).

The reflectance of basal-plane epitaxial layers of GaN has been measured between 5 and 30 eV, and Kramers-Kronig analyzed to get the dielectric function and the electron-energy-loss function. The second derivative of the reflectance with respect to energy was obtained in the region of Ga 3d→ conduction-band excitations. The latter show weak structure from transitions to Γ final states and stronger structures to final states along U, both split by the 0.40-eV Ga 3d spin-orbit splitting. The loss function exhibits two peaks, the stronger one at 19.0 eV, below the expected 23.3 eV, while the weaker one is at 23.2 eV.

2158 **Carbon KVV Auger line shapes of graphite and stage-one cesium and lithium intercalated graphite.** Murday, J.S.; Dunlap, B.I.; Hutson, F.L. II; Oelhafen, P. (Code 6170, Naval Research Laboratory, Washington, D. C. 20375). *Physical Review* [*Section*] *B: Condensed Matter;* **24**: No. 8, 4764-4770(15 Oct 1981).

A symmetry-resolved one-electron density of states (DOS) for graphite is extracted from existent x-ray photoelectron and x-ray emission data and used in conjunction with empirical atomic matrix elements to construct a carbon KVV Auger line shape for graphite which is in substantial agreement with experiment. For the intercalated graphites, an additional peak is added to the graphite one-electron DOS near the Fermi energy. In the absence of available XES data for C_8Cs and C_6Li, the energy and intensity of this peak are determined by fitting the C KVV Auger spectra. The enhanced intensities found for this peak, relative to the ultraviolet photoelectron spectroscopy data, are interpreted as being due to the screening charge surrounding the C 1s core. The measure of this enhancement corresponds to 0.5 and 0.6 electrons (intercalant charge donation plus screening) on the core-ionized carbon atom for the case of C_8Cs and C_6Li, respectively. No evidence is found for the selection rule or large matrix-element effects postulated in previous work.

2159 **Similarity of the laser- and thermally annealed Si(111) surfaces.** Zehner, D.; White, C.W.; Heimann, P.; Reihl, B.; Himpsel, F.J.; Eastman, D.E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review* [*Section*] *B: Condensed Matter;* **24**: No. 8, 4875-4878(15 Oct 1981).

Photoemission studies using synchrotron radiation show that laser-annealed Si(111)-(1 x 1) and Si(111)-(7 x 7) surfaces have very similar electronic structures; namely, both show (i) the same two surface state (each with a characteristic angular emission pattern), (ii) similar surface core-level spectra, and (iii) the same Fermi-level pinning. We observe that the (1 x 1) and cleaved (2 x 1) surfaces are not related as recently reported. Low-energy-electron-diffraction studies conclude that the (1 x 1) surface has a compressed ideal (1 x 1) geometry; this is inconsistent with a band-theory interpretation of our results.

2160 **Anharmonic relaxation times of molecular vibrational modes in alkali halide crystals.** Moerner, W.E.; Sievers, A.J.; Chraplyvy, A.R. (Laboratory of Atomic and Solid State Physics and the Materials Science Center, Cornell University, Ithaca, New York 14853). *Physical Review Letters;* **47**: No. 15, 1082-1085(12 Oct 1981).

Low-temperature infrared-saturation and hole-burning measurements have been performed on an internal vibrational mode of a spherical-top molecule embedded in a variety of alkali halide crystals. The vibrational relaxation times T_1 and T_2 satisfy the relation $T_2 \simeq 2T_1$ but T_1 ($<$ or $=$38 nsec) is orders of magnitude smaller than expected for multiphonon decay. A study of the alkali halide dependence of these relaxation times suggests that a specific combination of internal, local, and band modes is involved in the decay process.

2161 **One- and two-magnon excitations in a one-dimensional antiferromagnet in a magnetic field.** Heilmann, I.U.; Kjems, J.K.; Endoh, Y.; Reiter, G.F.; Shirane, G.; Birgeneau, R.J. (Riso National Laboratory, Roskilde, Denmark). *Physical Review* [*Section*] *B: Condensed Matter;* **24**: No. 7, 3939-3953(1 Oct 1981).

We have carried out a comprehensive experimental and theoretical study of the inelastic scattering in the one-dimensional near-Heisenberg antiferromagnet $(CD_3)_4N\,MnCl_3$ (TMMC) at low temperatures, 0.3$<$ or $=T<$ or $=$2.5 K, in magnetic fields varying between 0 and 70 kOe; the field is applied perpendicular to the chain axis. In zero field at long wavelengths we observe two sets of excitations, a low-energy acoustic branch corresponding to spin motion within the dipolar determined easy plane and a high-energy optical branch corresponding to oscillations out of the plane. For magnetic fields greater than 30 kOe and T$\simeq$2 K we observe as many as four distinct excitations: the two one-magnon modes plus two sharp excitations at higher energies. Our theoretical analysis suggests that the two higher-energy modes correspond to two-

magnon processes in the longitudinal response function. The theory, which is done within the harmonic approximation expanding out to fourth order in the magnon operators, gives a good qualitative description of the data but underestimates the two-magnon intensities by a factor of 2 or 3. We also observe a marked anticrossing of the one- and two-magnon branches; this latter result shows that anharmonic effects are quite important in the spin dynamics. Finally at T = 0.3 K and zero field we observe a gap of 0.1 meV in the acoustic spin-wave dispersion relation due to a very small in-plane anisotropy field of 71 x 30 Oe.

2162 **Ion beam characterization of the GaAs—GaAs oxide interface for plasma and anodic oxides.** Maggiore, C.J.; Wagner, R.S. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Vacuum Science and Technology;* **19**: No. 3, 463-466(Sep 1981).

Ion beam channeling has been used to measure the effects of oxide growth and annealing on the substrate at the GaAs—GaAs oxide interface. Plasma and anodic oxides have been grown on <100> GaAs substrates, and the oxides were removed with an etch in hydrofluoric acid. The substrates were then examined with a beam of 1.5 MeV ^{3}He particles channeled down the <100> axis. The resultant Ga and As surface peaks can be resolved with Rutherford backscattering and are a measure of the Ga and As at the substrate—oxide interface. Anodic oxides grown by the constant-current method (50 μA) show no change from virgin material at the interface; however, annealing of the oxide prior to its removal results in As enhancement at the surface (≈2.0 monolayers). Plasma oxides grown by direct immersion in an rf plasma show As enhancement at the interface without annealing. When grown in a fluorinated plasma, the data show an enhanced Ga surface peak consistent with a thicker interface and modified composition of the substrate. The differential measurements were made with a precision of +- 0.2 monolayer.

2163 **Effects of the environment on point-defect energy levels in semiconductors.** Dow, J.; Allen, R.E.; Sankey, O.F.; Buisson, J.P.; Hjalmarson, H.P. (Loomis Laboratory of Physics, Coordinated Science Laboratory, and Materials Research Laboratory, University of Illinois at Urbana—Champaign, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology;* **19**: No. 3, 502-507(Sep 1981).

Deep impurity energy levels within the band gap of a semiconductor can be altered and manipulated by changing the environment of the impurity. The effects of a second impurity, an interface, and a surface have been evaluated for substitutional deep levels in a variety of semiconductor hosts.

2164 **Electron transmission probabilities through GaAs/strained GaAsP/GaAs(100) heterostructures.** Osbourn, G.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology;* **19**: No. 3, 592-595(Sep 1981).

Results of a tight binding calculation of the transmission probabilities of electrons through GaAs/strained GaAsP/GaAs(100) heterostructures are presented. The GaAsP layer thicknesses considered are sufficiently thin that the GaAs/GaAsP lattice mismatch is accommodated by layer strain rather than dislocation generation. For layers with small GaP content, incident electrons in Bloch states near Γ can transport through the alloy in Bloch states that are also near Γ. Transmission probabilities are large and exhibit resonant (total) transmission at GaAsP layer thicknesses determined by the wavevector k of the accessible GaAsP Bloch states. For layers with large GaP content, incident electrons must either "tunnel" through the GaAsP evanescent states associated with the Γ minimum or undergo phononless intervalley transfer at the interface to the accessible Bloch states near X in GaAsP. For extremely thin GaAsP layer (less than a few lattice constants), the tunneling type process dominates. The phononless intervalley transfer process is found to occur with very small probability except for carrier energies and layer thicknesses corresponding to resonant transmission.

2165 **Study of stability of MIS polycrystalline silicon solar cells by Auger electron spectroscopy.** Lee, B.W.; Kuo, J.M.; Lalevic, B.; Anderson, W.A. (Department of Electrical Engineering, Rutgers University, Piscataway, New Jersey 08854). *Journal of Vacuum Science and Technology;* **19**: No. 3, 696-699(Sep 1981).

Auger electron spectroscopy and ion sputtering techniques were used to investigate the free surface composition and MIS solar cell fabricated on polycrystalline silicon. A layer of ~20 A of mixture of silicon oxide and chemisorpted oxygen atoms were found on the Si surface. For the Cr—Cu—Cr—SiO_2—Si solar cell, the copper layer is the key factor for reducing the series resistance of the metal layers. The pure oxide layer was found to be almost nonexistant and a mixture of silicon oxygen and chromium was detected between the silicon and metal interface. Compositions of the cell were investigated as a function of temperature. The results were used to estimate the lifetime of the cell. It was found that the cell should have a very long lifetime if operated under 200°C.

2166 **Optical emission studies of reactive species in plasma deposition.** Kampas, F.J.; Griffith, R.W. (Brookhaven National Laboratory Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **73**: No. 1, 1-5(Jun 1981). (CONF-810331—).

From Conference on tetrahedrally bonded amorphous semiconductors; Carefree, AZ, USA (12 Mar 1981).

Optical emission studies of the glow-discharge deposition of a-Si:H alloys reveal the presence of reactive species derived from process gases and impurities. Studies of the dependences of emission intensities upon depositon parameters elucidate the mechanisms of formation of these species. Effects of impurities detected by emission spectroscopy upon a-Si:H film electronic properties are discussed. A model of the chemical reactions involved in film growth is presented.

2167 **Characterization of the protonic distribution and environment in amorphous silicon-hydrogen alloys using proton NMR and ESR.** Jeffrey, F.R.; Lowry, M.E.; Garcia, M.L.S.; Barnes, R.G.; Torgeson, D.E. (Ames-Laboratory-USDOE and Department of Physics, Iowa State University, Ames, Iowa 50011). *AIP (American Institute of Physics) Conference Proceedings;* **73**: No. 1, 83-88(Jun 1981). (CONF-810331—).

From Conference on tetrahedrally bonded amorphous semiconductors; Carefree, AZ, USA (12 Mar 1981).

We present magnetic resonance data from a series of a-Si(H) samples deposited under varied hydrogen partial pressures. This parameter has been shown to be directly related to the sample-wide average proton density. The other sputtering parameters were maintained such that no dihydride bonding (as determined by the 890 cm^{-1}ir bending mode) is present. Measurements presented are the NMR absorption spectrum (from the Fourier transform of the free induction decay), relaxation time T_1, and ESR absorption. The NMR absorption spectrum identifies two distinct forms of H incorporation. One is a tightly clustered form, such as H bonded on the inner surface of a microvoid of maximum dimension 5A, while the other is a randomly distributed phase with local H density of 3.5 x 10^{21} cm^{-3}. The distributed phase H density is independent of the sample-wide average, indicating a fixed composition phase which occupies a larger percentage of the sample as H pressure is increased during deposition. This phase appears to extend to a maximum of 88% of the sample. The protonic spin-lattice relaxation time (T_1) measures the coupling of the spin system to its enviroment, "the lattice". For the series of samples, we find that T_1 first increases from 2.8 s to 44.8 s with increasing H content and then decreases to 8.1 s as H density is further increased. In an effort to understand this unusual relaxation behavior, we have made temperature dependant T_1 and ESR measurements. Utilizing these results, the protonic relaxation mechanism is discussed in terms "disorder mode" and electronic state models.

2168 **Relation between silicon-hydrogen complexes and microvoids in amorphous silicon films from IR absorption.** Soule, D.E.; Reedy, G.T.; Peterson, E.M.; McMillan, J.A. (Argonne National Laboratory, Argonne, IL 60439). *AIP (American Institute of Physics) Conference Proceedings;* **73**: No. 1, 89-94(Jun 1981). (CONF-810331—).

From Conference on tetrahedrally bonded amorphous semiconductors;

A line shape analysis was made of IR absorption bands observed by reflection mode measurements to 400 cm^{-1} on hydrogenated amorphous silicon a-Si:H films. Individual Gaussian absorption lines were resolved through a least-squares deconvolution of multiple stretch mode bands. Emphasis is made on the structural and optical trends toward low-temperature deposited films, with their relaxed open a-Si network containing microvoids. The vibrational behaviors of Si-H, Si-H_2 and Si-H_3 complexes were studied over a wide range of deposition temperatures T/sub D/ = 350 °C to -121 °C. Systematic vibrational frequency shifts were resolved for all complexes due to a shift in bond angle distortion with T/sub D/. Frequency shifts and line broadening effects identified the Si-H_3 complex as distinct in behavior within microvoids from Si-H and Si-H_2. In the limit of low T/sub D/, the observed frequencies approached closely those of representative substituted silane molecules establishing the identification of Si-Hn complexes and their corresponding structural relation to the bond angle distortion model.

2169 **Electronic states of an isolated phosphorus atom in an amorphous silicon matrix.** Ching, W.Y.; Lin, C.C. (Department of Physics, University of Missouri, Kansas City, Mo. 64110). *AIP (American Institute of Physics) Conference Proceedings;* **73**: No. 1, 151-155(Jun 1981). (CONF-810331—). Contract AC02-76CH00016.

From Conference on tetrahedrally bonded amorphous semiconductors; Carefree, AZ, USA (12 Mar 1981).

We study the electronic states of an isolated p atom in an amorphous silicon matrix in several possible bonding configurations. Cluster type of electronic structure calculations are performed on local bonding structures of PSi_3 and PSi_4 embedded in a random network of a-Si. The local density of states of P and nearby Si atoms are extracted. For PSi_3, we find a dominating P peak about 4 eV below the valence band edge which is consistent with photoemission experiment. The PSi_3 results show more structures and differ significantly from the photoemission data. The results for PSi_4 are qualitatively similar to those for PSi_3.

40 CHEMISTRY

REFER ALSO TO CITATION(S) 2971

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 1807, 2236, 2247, 2251, 2379, 2387, 2429, 2445, 2448, 2449, 2450, 2451, 2452, 2457, 2459, 2460, 2461, 2462, 2464, 2492, 2493, 2494, 2496, 2525, 2576, 2579, 2590, 2597, 2598, 2602, 2633

2170 (EUR—6629, pp 181-186) **Method for calibration of plutonium NDA.** Lemming, J.F.; Campbell, A.R.; Rodenburg, W.W. (Monsanto Research Corp., Miamisburg, OH (USA)). 1979. Dep. NTIS (US Sales Only).

From International meeting on monitoring of Pu-contaminated waste; Ispra, Italy (25 Sep 1979).

Calibration materials characterized by calorimetric assay can be a practical alternative to synthetic standards for the calibration of plutonium nondestructive assay. Calorimetric assay is an effective measurement system for the characterization because: it can give an absolute assay from first principles when the isotopic composition is known, it is insensitive to most matrix effects, and its traceability to international measurement systems has been demonstrated.

2171 (EUR—6629, pp 217-226) **Measurement of Pu contamination at the 10-nCi /g level in 55-gallon barrels of solid waste with a ^{252}Cf assay system.** Crane, T.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Dep. NTIS (US Sales Only).

From International meeting on monitoring of Pu-contaminated waste; Ispra, Italy (25 Sep 1979).

A combination active/passive nondestructive assay (NDA) system is described for the measurement of a wide range of plutonium-contaminated solid waste. The waste packaged in 55-gal (208 liter) barrels could be of either high or low density with gamma-ray radiation from fission products as high as 1000 R/h. The passive NDA measurement technique consists of counting coincident and total neutrons with ^3He-filled proportional detectors. The active assay, wich is made after the passive measurement, employs a cyclical irradiation by a ^{252}Cf neutron source followed by delayed neutron counting with the source transferred to a shielded storage container. Approximately 1000 s are used for the combination active/passive assay. The three standard deviation detectability limit is near the 10-nCi/g fiducial for the passive plutonium measurement and bellow the fiducial for the active measurement for barrels with a mass of 100 kg or more.

2172 (EUR—6629, pp 227-246) **Determination of Pu contained in low activity drums by gamma spectrometry and neutron counting.** Fiche, C.; Berne, R.; Lacruche, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). 1979. (In French). Dep. NTIS (US Sales Only).

From International meeting on monitoring of Pu-contaminated waste; Ispra, Italy (25 Sep 1979).

The aim of this work is the definition of a device for determining the quantity of plutonium contained in a drum of low activity waste, by simultaneously using the gamma spectrometry of isotope 239 and the detection of the spontaneous fission of the neutrons of even isotopes. The wastes under consideration are mainly composed of light hydrogenated substances of the vinyl, latex or paper type packed into cylindrical containers of under 225 litres capacity. Experiments have been carried out with models of various dimensions allowing for a parametric study of the count geometry, the effects of heterogeneity in the distribution of the fissile matter and that of space dilution. The results achieved and theoretical considerations have made it possible to evaluate the performance that can be expected from such a device. The detection limit is around 0.1 g of plutonium, with an accuracy of approximately 15% for a total amount of a few grams of plutonium. The restrictions due to possible contamination by gamma emitters and neutrons are discussed.

2173 (EUR—6629, pp 363-381) **Interpretational models of passive gamma and neutron assay systems.** Notea, A.; Segal, Y.; Bar-Ilan, A.; Knoll, A.; Shenhav, N. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). 1979. Dep. NTIS (US Sales Only).

From International meeting on monitoring of Pu-contaminated waste; Ispra, Italy (25 Sep 1979).

The interpretational model correlates the instrument readings with the actinides content in the waste item. A transparent model is essential for parameter study, calibration procedure design and uncertainty assessment. The paper summarizes a study on modelling for passive gamma and neutron assay techniques. A model is presented for one-shot high resolution gamma monitor based on multilines information. The model includes the leakage of scattered radiation. The nonhomogeneity of waste matrix and the non-uniformity of the gamma emitter distributions within the item volume are dealt by the probability methodology. Response functions for passive neutron assay based on Feynman's variance method and on covariance method are discussed.

2174 (IA—1356, pp 307-308) **Determination of the density of objects by means of densitometry of radiographs.** Zilber, R.; Kedem, D.; Bukshpan, S.; Gayer, A. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2175 (IAEA-TECDOC—246, pp 175-178) **Interlaboratory comparisons of low-level tritium measurements in water. Organized by IAEA.** Florkowski, T. (International Atomic Energy Agency, Vienna (Austria)). May 1981. Dep. NTIS (US Sales Only).

From Consultants group meeting on low-level tritium measurement; Vienna, Austria (24 Sep 1979).

The increase of the number of laboratories engaged in the routine measurements of tritium in water is noted. The increase was from 12 laboratories in 1963 to 41 in 1976. It is estimated that about 95% of existing active laboratories in assaying the environmental

tritium level take part in the intercomparison. The number of laboratories goes to saturation. Nevertheless, a few new laboratories set up in developing countries should be added to complete the picture for 1979. Increase of the lowest detectable tritium concentration and the analytical accuracy is also easily seen, however, difficult to be presented in numbers. In 1963 the lowest error of analysis was quoted as +-2 T.U. In 1969 it was already 0.4 and in 1976 0.03 T.U.

2176 (INIS-mf—6528, pp 30-33) **Determination of the concentration profile of the additives of semiconductor surface layers by neutron activation analysis (NAA).** Devai, A.; Toeroek, G. (Budapesti Mueszaki Egyetem (Hungary)); Zanati, T.; Puskas, L. (Egyesuelt Izzolampa es Villamossagi R.T., Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The aim of the NAA-based method described is to determine the dispersion profile of additives in semiconductor materials, especially in silicon, during their production. The continuous monitoring of Si concentration is attained by constant rate etching based on a continuous closed circulation system filled with the etching mixtures. Integral curves obtained by the registration of the intensity of the etching mixture are used to determine the concentration of the additive.

2177 (INIS-mf—6528, pp 70-73) **Investigation of soil samples by means of X-ray fluorescence analysis.** Hegedues, D.; Nagy, L.G. (Budapesti Mueszaki Egyetem (Hungary). Alkalmazott Kemiai Tanszek); Gresits, I. (CHINOIN Gyogyszer es Vegyeszeti Termekek Gyara Rt., Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The article deals with the determination of Ca, Fe, Cu, Zn, Br, Rb, Sr, Zr, Y and Mo in soils by energy dispersive X-ray fluorescence method. The exciting source was ^{125}I with 410 MBq activity. Qualitative results are given in tabulated form.

2178 (INIS-mf—6528, pp 74-77) **Examination of the trace element content of beetroot by X-ray fluorescence analysis.** Hegedues, D.; Nagy, L.G. (Budapesti Mueszaki Egyetem (Hungary). Alkalmazott Kemiai Tanszek); Gresits, I. (CHINOIN Gyogyszer es Vegyeszeti Termekek Gyara Rt., Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The paper deals with the determination of Mn, Fe, Cu, Zn, Br, Rb, Sr, Mo concentration in beetroot by energy dispersive X-ray fluorescence method. The exciting source was ^{125}I with 555 MBq activity. For the analysis Si(Li) semiconductor detectors were applied and for the data processing a minicomputer (type HP 9825 A) was used. Results are given in tabulated form.

2179 (INIS-mf—6528, pp 96-99) **Role of high-precision weighing in preparing radioactive certified reference materials.** Horvath, G..; Szokolyi, L. (Orszagos Meresuegyi Hivatal, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The microbalance is an appropriate device for high-precision weighing. The errors caused by the measuring device and measuring substance (radioactive solutions), the verification and periodic checking of the microbalance, the high-precision dilution of radioactive solutions and the preparation of probes for activity measurement are dealt with. The mode of preparation of radioactive liquid and solid certified reference materials is also discussed.

2180 (INIS-mf—6528, pp 138-141) **Role of neutron activation analysis in the elemental trace analysis of biological materials.** Laszlo, K.; Nagy, L.G.; Toeroek, G. (Budapesti Mueszaki Egyetem (Hungary). Alkalmazott Kemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The paper evaluates several popular trace element analytical techniques including neutron activation analysis (NAA), atomic absorption spectrometry (AAS) and X-ray fluorescence spectrometry (XRF). The criteria used in the comparison of the methods include sensitivity, specificity, accuracy and precision, single vs. multielement capability, time of analysis and general applicability. Emphasis is placed on their use in the analysis of biological and environmental materials (e.g. human blood, drinking-water, soil, sludge).

2181 (INIS-mf—6528, pp 219-223) **Determination of ^{137}Cs in environmental samples.** Segesvary, G.; Gimesi, O.; Banyai, E.; Farkas, A. (Budapesti Mueszaki Egyetem (Hungary). Altalanos es Analitikai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The aim of the present work was to develop a rapid method for the determination of ^{137}Cs in environmental samples. The main interferant is potassium. Cesium was separated from potassium by hexachloroplatinate (IV) acid added in substoichiometric amount. The cesium was measured in the form of hexachloroplatinate precipitate. According to the experience of the authors, potassium, over a certain concentration has no influence on the radioactive yield, corrected for the inactive yield, therefore precipitation was made from a solution saturated with respect to potassium chloride.

2182 (INIS-mf—6528, pp 224-227) **Separation of radiocarbon-labelled plant proteins by PAG electrophoresis, and the determination of the distribution of their radioactivity.** Simon, L.P.; Szarvas, T.; Pozsar, B. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Radiocarbon-labelled plant proteins were separated from cereal leaves with PAG electrophoresis. For the determination of the radioactivity of the separated proteins in the gel a convenient method was developed. The method is based on the combustion of the gels with H_2O_2 and on their solubilization in the liquid scintillation cocktail.

2183 (INIS-mf—6528, pp 275-278) **Portable chemical processing system.** Toeroek, G.; Ruip, J.; Vodicska, M. (Budapesti Mueszaki Egyetem (Hungary). Alkalmazott Kemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A semi-microanalytical, portable destructive processing and separating system is described. In its present configuration the system is applied for the chemical processing of biological and environmental samples after neutron activation.

2184 (INIS-mf—6528, pp 283-286) **System for the acquisition and processing of nuclear data.** Toeroek, G.; Zagyvai, P. (Budapesti Mueszaki Egyetem (Hungary). Alkalmazott Kemiai Tanszek); Kruppa, E. (Dunai Koeolajipari Vallalat, Szazhalombatta (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A system for data acquisition and processing for gamma-ray spectrometry and X-ray fluorescence spectrometry has been developed. The system includes two control units (an HP 9825A desktop calculator and TPA 1140 minicomputer), detectors, several multichannel analyzers and peripherals. The software material for processing spectra includes control and I/O operations and simple and sophisticated methods for peak analysis. In case of gamma spectra qualitative identification and quantitative analysis are available. Further developments are scheduled with respect to hardware and software.

2185 (INIS-mf—6528, pp 287-291) **Investigations of the rotating-disc spectral analysis method by a tracer technique.** Ujhidy, A.; Maleczki, E. (Veszpremi Vegyipari Egyetem, (Hungary). Radiokemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The rotating-carbon-disc spectral analysis method is frequently used for the analysis of trace impurities in solutions. Frequently, noble gas purging is used to reduce the matrix effects and the detection limits. The paper reports on the use of an isotope tracer method for the examination of excitation processes. ^{64}Cu and ^{99}Mo solutions with and without carriers were used under different excitation conditions and with different purging gases. Both the activity changes and the autoradiograms yielded results of practical importance.

2186 (INIS-mf—6528, pp 8-11) **Recovery of nanogram-mass tracer from large-volume liquid patterns.** Baranyai, L. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

During air-pollution investigations, the recovery of nanogram-mass Dy tracer from 500 cm^3 absorbing liquids has been attempted in order to make the tracer technically suitable for neutron-activation and at the same time to separate it from the most disturbing alkali elements. The recovery of the extraordinarily little mass tracer was carried out by adding different carriers artifically and co-precipitating them with the Dy tracer. The circumstances, the sensitivity and the efficiency of the recoveries are detailed.

2187 (INIS-mf—6528, pp 146-149) **Investigation of the extraction of rare earths from molten salts with the aid of tracers.** Lengyel, T. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Separations performed by solvent extraction from a molten salt phase offer the following advantages: no hydrolytic disturbing effects have to be taken into account, the theoretical treatment of experimental data becomes easier and relatively high selectivity coefficients can be achieved. These aspects have been proved to be valid in the course of the distribution measurements performed for several rare earths, using proper radioactive tracers. Many of the different solvent mixtures revealed synergistic effect which is promising from the point of view of separation efficiency.

2188 (INIS-mf—6528, pp 186-189) **Study of inorganic ion exchangers suitable for the separation of radioactive alkali metal ions.** Nagy, J.; Fuentes, R.S.; Madi, I. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Izotop Lab.). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The kinetic and thermodynamic properties of the exchange processes of cesium and rubidium ions on mixed ferrocyanides were investigated. The exchange capacity of the ion exchangers was determined by isotherm method. The mixed ferrocyanides are selective exchangers of heavy alkali metal ions, and they can be used to separate ^{137}Cs from uranium fission products and for the selective precipitation and determination of ^{137}Cs in natural waters.

2189 (INIS-mf—6528, pp 58-61) **Wear process analysis using neutron activation technique.** Fodor, J. (Autoipari Kutato Intezet, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A test procedure was worked out to analyse wear processes in real tribological systems using gamma-ray spectrometry of wear debris. The oil sample from the system was filtered and the residue was ashed and neutron-activated. The radioisotope mixture was analysed using Ge(Li) semiconductor detector and computer-controlled multichannel analyser PDP 8/F. In systems having oil filtration the oil filter or a part of it has to be analysed, too. From the wear data it was possible to determine the conditions of the trouble-free operation of the system. To increase the life-span of the engine air filter development was affected on the one hand, and the concentration of wear debris was decreased by better oil filtration on the other.

2190 (INIS-mf—6528, pp 66-69) **Radiometric method for the continuous determination of the ash content of low-grade coals.** Hazi, E.; Faludi, G.; Csapo, Z. (Veszpremi Vegyipari Egyetem (Hungary). Radiokemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A radiometric method and apparatus have been developed for the continuous determination of the ash content of low-grade coals. The apparatus can be used for continuous measurements in an industrial environment and for the control of an automatic system. The material to be tested is continuously delivered by a screw-feeder through the measuring compartment of the radiometric probe. The ash content determination is based on gamma absorption measurement. Making use of the increment of gamma reflection the radiometric method allows for the accurate determination of the space-filling and provides for the automatic correction necessary for the ash content determination.

2191 (INIS-mf—6542, pp vp) **Activation analysis of the forward-biased CdS-polysulphide electrolyte Schottky barrier.** Vainas, B.; Manassen, J.; Cahen, D.; Hodes, G. (Weizmann Inst. of Science, Rehovoth (Israel)). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2192 **Liquid-liquid fractionation of complex mixtures of organic components.** Colgrove, S.G.; Svec, H.J. (Iowa State Univ., Ames). *Analytical Chemistry;* **53**: No. 12, 1737-1742(Oct 1981). Contract W-7045-ENG-82.

A modified liquid-liquid extraction scheme has been developed which is applicable to complex mixtures of organic compounds. Fractionation into strong and weak acids, bases, polar and nonpolar compounds, aldehydes, and ketones provides chemical information useful in GC/MS identifications of components in mixtures. Advantages and problems attending fractionation of mixtures have been elucidated by the use of standards and mixtures containing trace amounts (1 to 10 ppM) of a variety of classes of organic compounds. Examples of possible artifacts occurring during a fractionation are described.

2193 **Determination of iodoamino acids and thyroid hormones in a urine matrix by neutron activation analysis.** Firouzbakht, M.L. (Univ. of Nebraska, Lincoln); Garmestani, S.K.; Rack, E.P.; Blotcky, A.J. *Analytical Chemistry;* **53**: No. 12, 1746-1750(Oct 1981). Contract AS02-76ER01617.A004.

By combining neutron activation detection with gel filtration and high-performance liquid chromatography (HPLC) employing C_8 and C_{18} reversed-phase columns, it is possible to detect and quantitate in a urine matrix trace quantities of 3-iodotyrosine, 3,5-diiodotyrosine, 3,5-diiodothyronine, 3,5,3′-triiodothyronine, and 3,5,3′,5′-tetraiodothyronine. Neutron activation of HPLC fractions where various thyroid derivatives elute is highly specific and sensitive for the ^{128}I activity. Experiments with spiked standards in urine show a quantitative response with a detection limit in the nanogram range utilizing a nuclear reactor with a power level greater than 1 x 10^{12} neutrons cm^{-2} s^{-1}.

2194 **Simultaneous determination of silica and alumina in bulk bauxite samples by fast neutron activation.** Borsaru, M.; Eisler, P.L. (CSIRO, Melbourne, Australia). *Analytical Chemistry;* **53**: No. 12, 1751-1754(Oct 1981).

A prototype of a bulk bauxite analyzer based on fast neutron activation analysis has been developed for simultaneously determining the chemical concentrations of alumina and silica in both dried and undried bulk bauxite samples (about 3.5 kg). The determination of alumina is based on measuring the count rate in the 0.844 MeV

γ-ray peak emitted by ^{27}Mg formed in the activation of aluminum. The determination of silica is based on measuring the count rate in the 1.78 MeV γ-ray peak emitted by ^{28}Al formed in the activation of silicon. The interference from alumina in the determination of silica was eliminated by measuring an additional parameter, the thermal neutrons underneath the bulk sample. The technique enables up to 10 analyses per hour with an accuracy (1 σ) of 0.28% silica and 0.9% alumina. The samples analyzed contained 48 to 62% alumina and 2 to 11% silica. The tests indicated that the accuracy of analysis was similar for samples which had been oven-dried (0 to 5% free moisture) and samples which were taken from the benefication plant with free moisture varying in a narrow range (10 to 14% free moisture). The results also indicated that crushing and grinding of samples did not significantly improve the accuracy.

2195 Microwave-excited atmospheric pressure helium plasma emission detection characteristics in fused silica capillary gas chromatography. Estes, S.A.; Uden, P.C.; Barnes, R.M. (Univ. of Massachusetts, Amherst). *Analytical Chemistry;* **53**: No. 12, 1829-1837(Oct 1981). Contract AC02-77EV04320.

Interfacing of fused silica gas chromatographic capillary columns to a microwave-excited atmospheric pressure helium plasma (MED) is investigated. The system for glass and fused silica capillary operation incorporates an interface where excess solvent can be vented by a chemically deactivated fluidic-logic gas switching system. A TM_{010} resonant cavity allows axial viewing of plasma emission. A quartz refractor plate background corrector improves selectivity ratios for elements whose emission occurs in the high-carbon (cyanogen) background region. Background emission characteristics of the helium plasma under various conditions are established from 200 to 500 nm. Calibration curves, selectivity ratios, and detection limits are established for the elements vanadium, niobium, chromium, molybdenum, tungsten, manganese, iron, ruthenium, osmium, cobalt, nickel, mercury, boron, aluminum, carbon, silicon, germanium, tin, lead, phosphorus, arsenic, sulfur, selenium, fluorine, chlorine, bromine, iodine, hydrogen, and deuterium.

2196 Scanning laser mass spectrometry for trace level solute concentration profiles. Conzemius, R.J.; Schmidt, F.A.; Svec, H.J. (Iowa State Univ., Ames). *Analytical Chemistry;* **53**: No. 12, 1899-1902(Oct 1981).

Scanning laser mass spectrometry (SLMS) is shown to support solid-state studies of migration of trace level solutes in solids. SLMS possesses the spatial chemical analysis capabilities necessary for these studies. Nuclides present in the solid specimen at less than 10 parts-per-million atomic (ppMa) are measured accurately with ordinary Faraday ion detectors. Spatial resolution for these studies is on the order of 25 to 50 μm. Quantification is demonstrated with standards where a relative deviation of a mean calibration factor is 1.6%. Scanning samples are achieved by sequential stepping or by a dynamic measuring technique. Several different solutes and solid matrices are measured concerned with actual solid-state experiments involving electric mobility and chemical diffusion.

2197 Extraction of alkali metal cations from aqueous solutions by a crown ether carboxylic acid. Strzelbicki, J.; Bartsch, R.A. (Texas Tech Univ., Lubbock). *Analytical Chemistry;* **53**: No. 12, 1894-1899(Oct 1981). Contract AS05-80ER-10604.

Solvent extraction of alkali metal cations from aqueous solutions by sym-dibenzo-16-crown-5-oxyacetic acid in chloroform is reported. Influence of pH, metal ion identity and concentration in the aqueous phase, and anion identity in the aqueous phase upon the concentrations of metal and complexing agent in the organic phase are assessed for single ion extractions. Extraction efficiency is insensitive to changing the aqueous phase anion from chloride to sulfate which demonstrates that the anion is not transferred to the organic phase during extraction. Extraction efficiency is very sensitive to the pH of the aqueous phase. For competitive ion extractions, the selectivity is $K > Na > Rb \geq Cs > Li$ for pH 6 to 7 and $Na > K > Rb \simeq Cs > Li$ for pH 8 to 12. The crown ether carboxylic acid exhibits extraction efficiencies and selectivities which surpass those of sym-dibenzo-16-crown-5 methyl ether or phenoxyacetic acid.

2198 Scanning laser mass spectrometry for trace level solute concentration profiles. Conzemius, R.J.; Schmidt, F.A.; Svec, H.J. (Iowa State Univ., Ames). *Analytical Chemistry;* **53**: No. 12, 1899-1902(Oct 1981). Contract W-7405-ENG-82.

Scanning laser mass spectrometry (SLMS) is shown to support solid-state studies of migration of trace level solutes in solids. SLMS possesses the spatial chemical analysis capabilities necessary for these studies. Nuclides present in the solid specimen at less than 10 parts-per-million atomic (ppMa) are measured accurately with ordinary Faraday ion detectors. Spatial resolution for these studies is on the order of 25 to 50 μm. Quantification is demonstrated with standards where a relative deviation of a mean calibration factor is 1.6%. Scanning samples are achieved by sequential stepping or by a dynamic measuring technique. Several different solutes and solid matrices are measured concerned with actual solid-state experiments involving electric mobility and chemical diffusion.

2199 Angular orientation of NH_3 on Ni(111) by low-energy photoelectron scattering. Kang, W.M.; Li, C.H.; Tong, S.Y.; Seabury, C.W.; Jacobi, K.; Rhodin, T.N.; Purtell, R.J.; Merrill, R.P. (Department of Physics and Surface Studies Laboratory, University of Wisconsin, Milwaukee, Wisconsin 53201). *Physical Review Letters;* **47**: No. 13, 931-934(28 Sep 1981).

The azimuthal variations in the photoemission cross section for the le molecular orbital of NH_3 adsorbed on Ni(111) are used to identify the angular orientation of the adsorbed molecules. From comparison of experiment and theory, it is possible to determine the NH-bond directions relative to the substrate. In addition, it is found that the observed strong azimuthal anisotropy comes mainly from direct interference of emissions from the le molecular orbital rather than from back-scattering off the substrate.

2200 Magnetic circular dichroism of excimer molecules. Islam, M.A.; Kponou, A.; Suleman, B.; Happer, W. (Columbia University, New York, New York 10027). *Physical Review Letters;* **47**: No. 9, 643-646(31 Aug 1981).

The magnetic circular dichroism of excimer absorption bands is used to obtain the first direct information about the angular momentum and angular momentum coupling schemes of excimer molecules.

2201 Calibration of a ^{238}Pu,Be facility for partial-body measurements of organ cadmium. Morgan, W.D.; Ellis, K.J.; Vartsky, D.; Yasumura, S.; Cohn, S.H. (Brookhaven National Lab., Upton, NY (USA)). *Physics in Medicine and Biology;* **26**: No. 4, 577-590(Jul 1981).

An improved instrument is described for the measurement of liver and kidney cadmium by in vivo neutron activation analysis in both occupationally and environmentally exposed persons. Detailed calibrations of the instrument used in a study of 83 male workers at a cadmium production plant are given. The importance of accurate organ localisation by ultrasound is stressed, without which errors of 40 and 25% in individual and group kidney measurements, respectively, can occur. The detection limit (2 SD of the background) is 2.2 mg cadmium in the kidney and 1.5 $\mu g\ g^{-1}$ (wet weight) in the liver for a local dose of 4.7 mSv. This instrument therefore combines the advantages of portability with high sensitivity of detection of cadmium.

2202 Certification of selected polynuclear aromatic hydrocarbons in standard reference material 1580, Organics in Shale Oil. May, W.E.; Brown-Thomas, J.; Hilpert, L.R.; Wise, S.A. (National Bureau of Standards, Washington, DC). pp 1-16 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

In this study, two independent analytical methods were used to determine the concentrations of individual PAH compounds in a shale oil matrix (SRM 1580) for the purpose of certifying that material as a Standard Reference Material. The use of a minimum of two independent methods was necessary because definitive methods for environmental trace organic analysis are nonexistent and certifi-

cation by interlaboratory concensus was undesirable. This SRM can serve as a benchmark against which the accuracy of emerging analytical techniques can be evaluated. SRM 1580 can also serve as an intercalibration material on which laboratories can evaluate the comparability of methods for compounds that have not yet been certified. (KRM)

2203 **Computer assisted structure-activity studies of polycyclic aromatic hydrocarbons.** Whalen-Pedersen, E.K.; Jurs, P.C. (Pennsylvania State Univ., University Park). pp 55-61 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

Structure-activity studies depend upon the ability to calculate numerical quantities to describe molecular features of organic compounds. These numerical descriptors serve to point out molecular features which provide insight into the mechanism of the biological activities of these compounds. The work reported here involves the development of a quantitative structure-property relationship using simple molecular structure descriptors as independent variables in a linear equation to predict gas chromatographic retention indices of a set of polycyclic aromatic hydrocarbons. (KRM)

2204 **Spot test for polycyclic aromatic hydrocarbons.** Johnson, L.D.; Luce, R.E.; Merrill, R.G. (Environmental Protection Agency, Research Triangle Park, NC). pp 119-131 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This report describes a rapid, sensitive and inexpensive test based on sensitized fluorescence for polycyclic aromatic hydrocarbons. These experiments define the limits of the spot test and allow comparison of its performance to other more specific methods. In addition, two environmental samples containing complex mixtures of organic material were screened using the spot test. Based on the range of sensitivities shown by PAH compounds in the spot test (1 to 10^4 pgl spot), agreement between the conventional methods and sensitized fluorescence methods is within an order of magnitude. (KRM)

2205 **Chemical characterization of mutagenic nitrogen-containing polycyclic aromatic hydrocarbons in fossil fuels.** Buchanan, M.V.; Ho, C.; Guerin, M.R.; Clark, B.R. (Oak Ridge National Lab., TN). pp 133-144 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981). Contract W-7405-ENG-26.

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

In this study, ammonia chemical ionization mass spectrometry has been employed to characterize the nitrogen containing compounds in the acetone subfraction of fine fossil fuel materials directly. The five acetone subfractions studied include three coal derived liquids, one shale derived liquid and one petroleum liquid. The compositions of these subfractions are reported and compared. (KRM)

2206 **Nitropyrenes: the isolation of tract mutagenic impurities from the toluene extract of an aftertreated carbon black.** Sanders, D.R. (Cabot Corp., Billerica, MA). pp 145-158 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This report illustrates an example of the conversion of a non-mutagenic PAH to a direct acting mutagenic nitro-PAH. It had been found previously that a xerographic toner contained potent direct-acting mutagens elutobal with acetone. The origin of the mutagenicity resided in the particular grade of aftertreated carbon black (ATCB) used in the toner formulation. This paper describes the effect to isolate and identify the mutagenic impurities from the ATCB. To find the mutagens, it was necessary to fractionate the toluene extract of the ATCB. This led to a practical analytical method for trace analysis of adsorbed nitropyrenes. (KRM)

2207 **Use of coupled-column and high resolution liquid chromatography in the analysis of petroleum and coal liquid samples.** Katz, E.; Ogan, K. (Perkin-Elmer Corp., Norwalk, CT). pp 169-178 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

In order to identify and quantitate individual PAH in complex samples, a two-dimensional liquid chromatography technique for sample preparation has been developed. This paper demonstrates the use of the two-dimensional fractionation system in combination with the high-resolution analytical method for the preliminary determination of selected PAH's in petroleum, coal liquid and shale oil sapmles. (KRM)

2208 **Rapid analysis of gaseous PAH and other combustion related compounds in hot gas streams by APCI/MS and APCI/MS/MS.** Sakuma, T.; Davidson, W.R.; Lane, D.A.; Thomson, B.A.; Fulford, J.E.; Quan, E.S.K. (SCIEX Inc., Thornhill, Ontario). pp 179-188 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

As an alternative to the long and complicated traditional methods for the extraction and subsequent analysis of PAH present in particulates, soot, and fly ash, atmospheric pressure chemical ionization coupled with ion detection by mass spectrometry (APCI/MS) (TAGA) offers a means for the rapid analysis of PAH in the gas phase. In this study, a standard solution was prepared and introduced into real stack gas emitted from a coal-fired cement kiln stack at the head of a heated all-glass sampling line which had been attached to the stack and a TAGA 3000 system for the determination of line transmission efficiencies and detection limits of the PAH. (KRM)

2209 **Formation of polycyclic aromatic hydrocarbons in premixed flames: chemcal analysis and mutagenicity.** Prado, G.; Westmoreland, P.R.; Andon, B.M.; Leary, J.A.; Biemann, K.; Thilly, W.G.; Longwell, J.P.; Howard, J.B. (Massachusetts Inst. of Tech., Cambridge). pp 189-198 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The concentration, detailed chemical composition and mutogenic activity of PAH collected from well-characterized laboratory flames were measured and their relation to combustion parameters were studied. In addition, the important question of partitioning of PAH between the vapor phase and the solid particulate phase (soot) was addressed. (KRM)

2210 **Applications of on-line high performance liquid chromatography/rapid scanning ultraviolet spectroscopy to characterization of polynuclear aromatic hydrocarbons in complex mixtures.** Choudhury, D.R. (New York State Dept. of Health, Albany). pp 265-276 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper describes a rapid scanning spectrophotometer based on a uv-enhanced silicon target vidicon (STV) tube coupled with an optical multichannel analyzer (OMA) for determining the uv spectra of HPLC eluates in a continuous flow mode. This investigation addresses the applicability of uv spectra to the identification of HPLC-separated PAHs in two environmental samples. (KRM)

2211 In situ determination of the chemistry of PAH on particle surfaces. Cabaniss, G.E.; Linton, R.W. (Univ. of North Carolina, Chapel Hill). pp 277-286 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper examines the utility of modern surface spectroscopic techniques, particularly photoacoustic spectroscopy (PAS), for the in situ determination of sorbed PAH on particulate materials. The results obtained using PAS of fluorene or fluorenone adsorbed on particulates illustrates the advantages of in situ characterization. (KRM)

2212 Use of mixed phases for enhanced gas-chromatographic separation of polycyclic aromatic hydrocarbons. II. Predication of retentions with open-tublar columns of high efficiency with liquid-crystal solvents. Laub, R.J.; Roberts, W.L.; Smith, C.A. (Ohio State Univ., Columbus). pp 287-295 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The development of high-resolution glass-capillary columns has greatly expanded the utility of gas chromatography (gc) for the separation of complex mixtures, such as those encountered in PAH analysis. To achieve both high efficiency and high selectivity, blended stationary phases comprising moderate concentrations of liquid crystal in admixture with silicone gums can be used. In this paper, the practicability of low concentrations of liquid crystal in silicone-gum diluents is examined. (KRM)

2213 Use of reverse phase concentrator columns for the determination of trace level polynuclear aromatic hydrocarbons in water. Marsh, D.G.; McNair, H.M. (Virginia Polytehnic Inst. and State Univ., Blacksburg). pp 297-305 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

Currently the predominant analysis method for water samples containing PAH is reverse phase, High Performance Liquid Chromatography (HPLC) with fluorescence detection. The most commonly used approach for trace concentration of PAH has been the use of extraction procedures as used by the EPA in method 610. This paper discusses a second approach which involves the use of the adsorbent, octadecylsilane (C-18) coated silica, to remove compounds from large samples of water followed by removal of the concentrate with a strong solvent. The results indicate that the latter method is a feasible alterative to EPA method 610 for some situations. Good reproducibility of retention times and recovery are obtained with limits of detection in the mid-ppt. (KRM)

2214 Analysis and assessment of PAH from coal combustion and gasification. Nichols, D.G.; Gangwal, S.K.; Sparacino, C.M. (Research Triangle Inst., Research Triangle Park, NC). pp 397-406 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

While coal combustion has been the primary mode for coal utilization for many years, major plans are now in place to produce synthetic fuels from various coals of the country. Therefore, the products and potential emissions from coal gasification operations are of major interest so that appropriate designs, controls, and standards will be established. This paper presents the results of the gasification of selected US coals in a laboratory-scale facility. Emphasis is placed on the study of the environmental aspects of coal conversion. (KRM)

2215 PAH profile analysis by capillary column-gas chromatography using the correlation between connectivity constants and retention indices. Lao, R.C.; Lee, S.W.; Thomas, R.S. (River Road Labs., Ottawa, Ontario). pp 407-416 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper investigates the relationshp between the retention and connectivity indices for some polycyclic aromatic hydrocarbons to aid in the identification of gas chromotographic peaks. Once the relationship is established, the connectivity index which is easily computable topological parameter, may be used as a significant identification aid for unknown compounds. (KRM)

2216 Evaluation of method detection limits and analytical curve for EPA method 610-PAH. Cole, T. (Battelle Columbus Labs., OH); Riggin, R.; Glaser, J. pp 439-454 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The purpose of this study is to critically evaluate an analytical method for PAH designated by EPA as method 610. This method utilizes high performance liquid chromatography with uv and fluorescence detection. The method detection limit and the analytical curve, or linear range, of the method are examined. The results support the validity and usefulness of method 610 without modification. (KRM)

2217 Compounds associated with diesel exhaust particulates. Hites, R.A. (Indiana Univ., Bloomington); Yu, M.L.; Thilly, W.G. pp 455-466 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981). Contract AC02-80EV10449.

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper is concerned with the high emission of particulates and associated organic compounds from diesel engines. Although these particulates are mostly carbon, 10 to 40% by weight can be extracted with organic solvents. In this paper, the chemical composition of two subfractions of diesel particulate extra tables which have been shown to be mutagenic are discussed. (KRM)

2218 Chemical properties of bacterial mutagens in stack collected coal fly ash. Hansen, L.D. (Brigham Young Univ., Provo, UT); Fisher, G.L.; Chrisp, C.E.; Eatough, D.J. pp 507-517 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981). Contract AC02-80EV10405.

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper describes research carried out on the extractable mutagenic fraction of coal fly ash. Specifically, the work was designed to establish if the mutagenic compounds are: (a) volatilized or decomposed by heating; (b) inorganic, organic, or a combination; and (c) acidic, basic, or neutral. (KRM)

2219 Active sites in hexacyclic carcinogens probed by the fluorine substitution methodology. Sardella, D.J.; Boger, E.; Ghoshal, P.K. (Boston College, Chestnut Hill, MA). pp 529-538 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper examines the fluorine substitution methodology as it applies to dibenzo(a,i)pyrene (DB[a,h]P), and dibenzo (a,h) pyrene (DB[a,h]P), the most potent Sarcomagenic PAH. Derivatives of DB(a,i)P and DB(a,h)P fluorinated in both bay-region benzo rings were assayed for both carcinogenic and mutagenic activity. The results indicate that metabolic activation of DB(a,i)P

and DB(a,h)P occurs in the bay-region benzo rings, via formation of dihydrodiols as proximate carcinogens, and, most likely, dehydrodiol epoxides as ultimate carcinogens. Fluorine substitution in the benzo rings blocks metabolism, perhaps by preventing initial epoxidation. (KRM)

2220 **Analysis of polynuclear aromatic hydrocarbons in sediment cores fron two remote Adirondack Lakes by high resolution gas chromatography/mass spectrometry.** Tan, Y.L.; Heit, M. (Dept. of Energy, New York, NY). pp 561-570 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

In this report, the changes in the concentrations of three-ring to seven-ring parental, alkylated, and partially hydrogenated PAH with depth in sediment cores taken from Sagamore Lake and Woods Lake in the New York State Adirondack State Park have been measured. Since many of the lakes in this area have been affected by acid rainfall, it was hoped that the analyses of sediments in these lakes would provide information on both the biogenic and abiogenic, mostly anthropogenic, origins of the PAH. (KRM)

2221 **Environmental assessment of PAH emissions from residential wood-fired stoves and fireplaces.** Peters, J.A.; Deangelis, D.G.; Hughes, T.W. (Monosanto Research Corp., Dayton, OH). pp 571-581 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper provides a preliminary emissions characterization of emissions from residential combustion sources. Major emphasis was organic emission specification, which included characterization and quantification of PAH. Another objective of this project is to assemble a data lease on usage and patterns of residential combustion of wood. (KRM)

2222 **Density and particle size of colloidal materials measured by carrier density variations in sedimentation of field-flow fractionation.** Giddings, J.C.; Karaiskakis, G.; Caldwell, K.D. (Univ. of Utah, Salt Lake City). *Separation Science and Technology;* **16**: No. 6, 607-618(1981). Contract AC02-79EV10244.

A new approach has been developed to yield both the particle density and particle mass (or size) of colloidal materials using a sedimentation field-flow fractionation system. The method involves varying the density of the carrier fluid, in the present case using aqueous sucrose solutions. Five polystyrene latex bead samples with different diameters were subjected to the procedure. These provided experimental density values all within 0.4% of the manufacturer's value. Particle sizes determined experimentally agreed quite well both with manufacturer's values and with diameters obtained from previous FFF experiments using a carrier of constant density. The method has considerable promise for characterizing particle mass (size) and density parameters in complex colloidal materials.

2223 **Concentration and analysis of dilute colloidal samples by sedimentation field flow fractionation.** Giddings, J.C.; Karaiskakis, G.; Caldwell, K.D. (Univ. of Utah, Salt Lake City). *Separation Science and Technology;* **16**: No. 6, 725-744(1981).

An on-channel concentration procedure is described in which large volumes of dilute colloidal materials can be concentrated at the head of an FFF channel in preparation for separation and analysis. The theory of the procedure is described, with particular focus on expected perturbations in retention and plate height due to the finite initial zone length. Two sizes (0.357 and 0.481 μm) of polystyrene latex beads diluted in volumes of up to 50 ml are used as model colloids. Separation of the two bead sizes is demonstrated. The beads are then subjected to careful retention and plate height measurements and the results compared to theoretical expectations. Certain anomalies are noted which may relate to the reversible adhesion of the particles to the channel wall. Possible extensions and ramifications of the technique are noted.

2224 **Ion source for IMA with both polarities and its applications.** Tamura, H.; Ishitani, T.; Kanomata, I. (Hitachi Ltd., Kokubunji, Tokyo (Japan). Central Research Lab.); Shibata, A. pp 214-220 of Secondary ion mass spectrometry. Fundamentals and applications. Someno, M. (Tokyo Inst. of Tech. (Japan)); Wittru, D.B. Tokyo, Japan; Riaru-Kogeisha Ltd. (Mar 1979).

From 2. Japan-United States joint seminar on secondary ion mass spectrometry; Takarazuka, Hyogo, Japan (23 Oct 1978).

It has been proven to be difficult to make the conventional ion probes for ion microprove analyzers (IMA) to operate well, due to poor ion current availability. The authors have developed a new ion gun for this purpose. The ion gun comprises a new control electrode as well as a conventional cathode, an intermediate electrode, an anode and an extracting electrode. The control electrode is supplied potential either in positive or negative polarity. Summarizing the experimental results, the authors have obtained the following results. (1) Large current output of both positive and negative ions can be extracted by the design with the control electrode, (2) primary ion current is varied over a wide range due to the voltage control of the control electrode, and (3) ion current efficiency is improved 10 times as high as conventional design by optimizing the control electrode potential. Also a new technique for the prevention of specimen charge-up utilizing secondary electron emission under the irradiation of negative ion beam is reported. The operating mechanism for charge neutralization is described. The analysis of insulator materials has been conducted on inorganic specimens such as NB, mica, Al_2O_3 and SiO_2, and organic specimens such as mylar, silicone rubber, amino acids and gelatine. By these results, it is believed that an analytical technique has been established for insulating materials with charge neutralization.

2225 **EHD ion sources for SIMS applications.** Krohn, V.E.; Ringo, G.R.; Johnson, C.E. (Argonne National Lab., IL (USA)). pp 227-231 of Secondary ion mass spectrometry. Fundamentals and applications. Someno, M. (Tokyo Inst. of Tech. (Japan)); Wittru, D.B. Tokyo; Riaru-Kogeisha Ltd. (Mar 1979).

From 2. Japan-United States joint seminar on secondary ion mass spectrometry; Takarazuka, Hyogo, Japan (23 Oct 1978).

The scanning ion microprobe with a secondary-ion mass analyzer is the most practical instrument now available for finding the location of specific stable isotopes in experimental samples. Unfortunately, the space resolution of existing ion microprobes is seriously limited, giving perhaps 1 μm resolution at best. The limitation is almost entirely from aberration. The original work by the author was done with a hollow tungsten needle, in which enough gallium was forced so as to form a cone on the 120 μm diameter tip of the tungsten needle. Then the efficiency of the secondary-ion analyzer was improved in two ways. In the system with the microprobe described earlier and the analyzer of improved efficiency, the background was next reduced by double labelling and growing biological tissues. Finally, as new analyzers for secondaries, a very interesting identification scheme has appeared, that will distinguish ^{14}C from ^{14}N and may be cheaper than a mass spectrometer with resolution of 10^4. There is another analyzing technique even more promising, which uses high-power laser beam parallel to the surface of a specimen and focused on the volume where the secondaries first emerge. If a curved mirror reflects and refocuses the beam back to the same volume, it would be possible to use two-photon absorption to cancel the Doppler effect to first order and to observe fluorescence from particular isotopes with reasonable efficiency. This might be the most compact and economical of the methods now in sight.

2226 (CEA-CETAMA—7, pp vp) **Plutonium volumetric titration after reduction on a Jones' column.** [nd]. (In French). Dep. NTIS (US Sales Only).

In Analysis methods. (Revised methods).

A description is given of a plutonium analysis method, in hydrochloric or sulfuric solution, for plutonium content over 2 mg, by reduction from plutonium IV to plutonium III in a Jones' column. Volumetic titration is by ceric sulfate with ferrous orthophenanthroline.

2227 (CEA-CETAMA—7, pp vp) **Analysis of uranium and some uranium compounds or alloys. Iron spectrophotometric determination.** [nd]. (In French). Dep. NTIS (US Sales Only).

In Analysis methods. (Revised methods).

Iron is determined in uranium, uranium oxides (UO_2, UO_3, U_3O_8), ammonium diuranate, U-Al-Fe type alloys containing about 700 ppm Al and 300 ppm Fe, UMo type alloys containing about 1.1 percent Mo. The method is applicable for iron content between 25 to 500 ppm with respect to uranium contained in the material.

2228 (CEA-CETAMA—7, pp vp) **Plutonium fluorides analysis. Fluorine content.** [nd]. (In French). Dep. NTIS (US Sales Only).

In Analysis methods. (Revised methods).

Fluorine is determined in plutonium hexafluorides by pyrohydrolysis and titration of entrained hydrofluoric acid.

2229 (CEA-CETAMA—7, pp vp) **Plutonium analysis. Thorium spectrophotometric determination.** [nd]. (In French). Dep. NTIS (US Sales Only).

In Analysis methods. (Revised methods).

Thorium determination in plutonium, applicable for content between 20 to 200 ppm, is by hydrochloric acid dissolution, oxidation of plutonium by concentrated nitric acid, and separation of most of the plutonium on an anion exchanger. The remaining plutonium is reduced by hydroxylamine hydrochloride and formation of the thorium - thorin complex. Spectrometry is at 545 nm.

2230 (CEA-CETAMA—7, pp vp) **Analysis of plutonium in solution. Plutonium spectrophotometric determination.** [nd]. (In French). Dep. NTIS (US Sales Only).

In Analysis methods. (Revised methods).

Determination of plutonium in solution by reduction to the valency state III with hydroxylamine and spectrometry at 600 nm, applicable for plutonium content between 0.2 to 150 g/l.

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REFER ALSO TO CITATION(S) 2254

2231 (INIS-mf—6528, pp 142-145) **Moessbauer study of Fe/SiO_2 and $RuFe/SiO_2$ catalysts prepared from carbonyl clusters.** Lazar, K.; Guczi, L. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest); Nagy, D.L. (Koezponti Fizikai Kutato Intezet, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

High dispersity Fe/SiO_2 and $RuFe/SiO_2$ catalysts were prepared from carbonyl clusters and investigated by Moessbauer spectroscopy. The spectra were recorded after each step of the preparation (impregnating, reduction, etc) and a strong interaction was observed between the support material and the metal, namely Fe was oxidized by the support material (Cab-O-Sil), the reduction was retarded in the presence of Ru and the formation of carbides was hindered.

2232 (INIS-mf—6528, pp 38-41) **Accelerated conversion coating on aluminium.** Drozda, T. (Magyar Asvanyolaj es Foeldgaz Kiserleti Intezet, Veszprem); Maleczki, E.; Varga, I. (Veszpremi Vegyipari Egyetem (Hungary). Radiokemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

$K_3[Fe(CN)_6]$ is often used as an accelerator in baths applied to produce chromate coating on aluminium surface. The effect (mechanism of action) of the accelerator on the formation of chromate coating was investigated by tracer method. ^{51}Cr and ^{59}Fe isotopes were used for labelling the components of the coating bath. The tracer method was completed by EDAX Scanning Electron Microscopy and Moessbauer Spectrometry. The conclusions based on the results were extended to other accelerators.

2233 (INIS-mf—6528, pp 84-87) **Application of radiotracer method to the investigation of electrosorption phenomena.** Horanyi, G. (Magyar Tudomanyos Akademia Koezponti Kemiai Kutato Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The paper deals with the application of radiotracer method to the investigation of electrosorption phenomena. The advantages of the method are demonstrated through examples referring to the study of electrosorption processes of labelled ions and organic compounds at platinized platinum electrodes. The use of radiotracers - ^{14}C, ^{36}Cl, ^{32}S, etc. -in conjunction with electrochemical measurements permits the study of some subtle details of the adsorption processes.

2234 (INIS-mf—6528, pp 126-129) **Study of heterogeneous exchange-reactions on barytes and determination of their specific area.** Konya, J.; Imre, L. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Izotop Lab.). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The heterogeneous isotope-exchange process of $^{140}Ba^{2+}$ on barytes, activated barytes and $BaSO_4$ was investigated. The exchange-isotherm were determined and specific surface was calculated. The specific area was measured by BET-method, too. In the case of barytes and $BaSO_4$ the results obtained by the two methods are in good agreement.

2235 (INIS-mf—6528, pp 130-133) **Investigation of heterogeneous isotope exchange on crystalline zirconium phosphate.** Koernyei, J.; Szirtes, L. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The alkali metal forms of α-zirconium phosphate and the sodium forms of γ-zirconium phosphate were synthesized. The kinetics of the heterogeneous isotope exchange, controlled by the self-diffusion of alkali metal ions in the crystals, was investigated by tracer technique using ^{24}Na, ^{42}K, ^{86}Rb, ^{134}Cs isotopes. The self-diffusion constant was evaluated by graphical method and the activation energy of the process was calculated using the Arrhenius equation.

2236 (INIS-mf—6528, pp 150-153) **Preparation, characterization and application of titanium phosphate sorbent.** Ludmany, A.; Toeroek, G.; Nagy, L.G.. (Budapesti Mueszaki Egyetem (Hungary). Alkalmazott Kemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A standard method was elaborated to prepare titanium phosphate for the removal of some alkaline radioions from strong mineral acidic media. An elution chromatographic technique was used to characterize the sorption properties of the preparations. Decontamination factors for these radioions were about 10^3 order of magnitude at a column loading of 1 mg ion/g sorbent. Some chemical and physico-chemical parameters of the sorbents (e.g. chemical composition, solubility, crystal structure, thermogravimetric properties, specific surface area, etc.) were determined in order to find a property which can be used for the characterization of the preparations.

2237 (INIS-mf—6528, pp 190-193) **Study of porous sorbents by isotopic molecular exchange method.** Nagy, L.G.; Foti, G.; Moravcsik, G. (Budapesti Mueszaki Egyetem (Hungary). Alkalmazott Kemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The equilibrium isotopic molecular exchange is an exchange of identical molecules between equilibrium phases in which the isotope ratio of one or more elements is different. Studying a solid/liquid adsorption equilibrium system conclusions can be drawn

from the exchange rate on the accessibility and characteristics of the porous adsorbent. The authors give discussion of the experiments: the solids under investigation are porous and non-porous silica gel and activated carbon. The liquids used are benzene, heptane and ethanol.

2238 (INIS-mf—6528, pp 228-231) **Surface reactions of molybdenum trioxide hydrate in aqueous media.** Szalay, T.; Pasztor, E. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Fizikai Kemiai Tanszeke). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

To improve the properties of the wire and sheet products of molybdenum small quantities of doping materials can be used. In the initial stage of the production molybdenum is present as molybdenum trioxide hydrate. At first the reactions between the doping materials and this compound of molybdenum were studied. Potassium-42 and iron-59 radioactive isotopes were used for the investigations. The cations studied are bonded in relatively large quantities on the surface of the investigated molybdenum trioxide hydrate (MoO_3x0.4 H_2O). The small dependence of these surface processes on the concentration of the hydrogen ion indicates that they have not primarily an exchange character.

2239 (INIS-mf—6528, pp 279-282) **Water decontamination by zirconium phosphate sorbents.** Toeroek, G.; Vajda, N.; Foti, G.; Nagy, L.T. (Budapesti Mueszaki Egyetem (Hungary). Alkalmazott Kemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Distilled and tap water containing Cs^+ ions was decontaminated by zirconium phosphate sorbents of amorphous structure. ^{137}Cs was applied as tracer. The sorption characteristics of a support-free sorbent were compared with those of zirconium phosphate on activated carbon.

2240 (INIS-mf—6542, pp vp) **Effect of light-induced selective corrosion on the properties of Cd-chalcogenides based photoelectrochemical cells.** Tenne, R.; Hodes, G.; Manassen, J.; Cahen, D. (Weizmann Inst. of Science, Rehovoth (Israel)). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2241 **Kinetics of the Cl—H_2 system. I. Detailed balance in the Cl+H_2 reaction.** Miller, J.C.; Gordon, R.J. (Department of Chemistry, University of Illinois at Chicago Circle, Chicago, Illinois 60680). *Journal of Chemical Physics;* **75**: No. 11, 5305-5310(1 Dec 1981).

A well-known problem in chemical kinetics is the observation that the ratio of the measured rate constants for the reactions Cl+H_2 and H+HCl apparently does not equal the known equilibrium constant. Previous work has indicated that the difficulty exists in the H+HCl measurements, which were complicated by wall effects and secondary reactions of H. We have measured both rate constants over the temperature range 200—500 K, using a resonance fluorescence—flash photolysis apparatus in which wall effects were insignificant. The ratio of our measured rate constants is in excellent agreement with detailed balance.

2242 **Kinetic isotope effects: Theoretical prediction of the thermal rate coefficient for the reaction D+O_2→OD+O.** Miller, J.A. (Combustion Physics Division, Sandia National Laboratories, Livermore, California 94550). *Journal of Chemical Physics;* **75**: No. 11, 5349-5354(1 Dec 1981).

Quasiclassical trajectory (QCT) and quasiclassical trajectory quantum mechanical threshold (QCT—QMT) calculations are reported for the reaction D+O_2→OD+O. The thermal rate coefficient from the QCT—QMT analysis was determined to be k_2 = 8.12 x 10^{13}T/sup -0.659/ exp(-15 041/RT) cm^3/mol s, for 250<T<2500 K, in excellent agreement with the experimental results available. Comparing with the QCT—QMT result [J. Chem. Phys. 74, 5120 (1981)] for (R1) H+O_2→OH+O, the ratio k_2/k_1 is found to vary from 7.5 at 250 K to 0.8 at 2500 K. The primary isotope effects controlling this difference are the difference in zero-point vibrational energies of the product diatoms at low temperature and the difference in reactant collision frequencies at high temperature. In addition the calculations show slightly less negative Arrhenius curvature (n_2 = -0.659, n_1 = -0.816) for R2 than for R1, an effect anticipated from the previous analysis. However, the magnitude of the difference between n_1 and n_2 is approximately the same as estimates of the maximum uncertainty in the calculations themselves. It is concluded that a factor of 2 in the mass of the attacking atom is not sufficient to distinguish accurately differences in Arrhenius curvature arising from the L+HH mass combination of the reactants, either theoretically or experimentally.

2243 **Corresponding states correlation of the homogeneous nucleation thresholds of supercooled vapors.** McGraw, R. (Environmental Chemistry Division, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **75**: No. 11, 5514-5521(1 Dec 1981).

The homogeneous nucleation thresholds for a number of vapors are examined in dimensionless corresponding states form. Strong correlations in behavior are observed which are independent of specific nucleation models. In particular, the influence of molecular structure and degree of intermolecular association on nucleation is addressed. Five classes of vapors are included as part of an extensive survey of reported critical supersaturation ratio measurements: simple atomic and molecular vapors of high rotational symmetry, alkane and alkylbenzene vapors, associated vapors (e.g., organic acids), and vapors condensing to associated hydrogen-bonded liquids (e.g., the lower molecular weight alcohols and water). The classical Becker—Doering—Zeldovich nucleation theory is recase in dimensionless form based on empirical relations for the surface tension and density of a simple fluid. Pitzer's acentric parameter is used to correlate departures from simple behavior for some of the more complex vapors included in the survey. Only those vapors which condense to form strongly associated liquids show a pattern of nucleating at supersaturations less than those of the corresponding simple fluid.

2244 **Reactions of the Xe($^3P_1$) resonance states with halogen donor molecules.** Brashears, H.C. Jr.; Setser, D.W. (Kansas State Univ., Manhattan). *Journal of Physical Chemistry;* **84**: No. 2, 11-13(1980). Contract AS02-76DP40027.

The formation of KrX* and XeX* (X=F, Cl, Br, and I) from the reaction of the ($^3P_1$) resonance states of the rare gases with halogen donors is reported. The experimental procedure is described. The low pressure emission spectra of XeX and KrX from these reactions are compared to that from the ($^3P_2$) metastable atom reactions. Relative rate constants are estimated for formation of the B and C states of XeCl for a series of chlorinated reagents. From the pressure dependence of the XeCl and XeF B/C ratios, values are assigned for the transfer rate constants for He, Ne, and Ar bath gases. (BLM)

4003 Organic Chemistry

2245 (INIS-mf—6528, pp 34-37) **Investigation of catalytic transformation of cyclohexanol applying ^{14}C as tracer.** Dobrovolszky, A.; Paal, Z.; Tetenyi, P. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Catalytic transformations of cyclohexanol in the presence of VIII B metals were studied applying ^{14}C as tracer. Reacting mixtures of labelled and unlabelled components were used to detect the transformation processes of cyclohexanol into cyclohexanone, phenol, benzene, etc. by measuring the special activity ratios of the species.

2246 (INIS-mf—6528, pp 42-45) **Effect of ortho substituents on phenyl ester reactivity in nucleophilic substitutions.** Dutka, F.; Koemives, T.; Marton, A.F. (Magyar Tudomanyos Akademia Koezponti Kemiai Kutato Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The paper compares the reactivities of ortho- and para-substituted phenyl acetates studying isotopic acyl exchange with ^{14}C tracer and aminolysis with spectrophotometry. In aminolysis the ortho-substituted esters reacted more rapidly than their para isomers. The increased reactivity is attributed to the ortho-substituted proton acceptor acting as general base catalyzer in aminolysis but not in isotopic acyl exchange.

2247 (INIS-mf—6528, pp 88-90) **Investigation of pesticide degradation in surface waters.** Horvath, L. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The degradation of organophosphorus and thiocarbamate pesticides was investigated using isotope tracer methods. The hydrolysis (degradation) of ester-type pesticides was studied by radiometric enzyme inhibition method in aqueous medium with ^{14}C as tracer. The hydrolysis of S-ethyl-N,N-dipropylthiocarbamate prerequired the oxidation of the parent compound.

2248 (INIS-mf—6528, pp 171-174) **Isotopic double labelling method to study the mechanism of catalytic reactions.** Matusek, K.; Guczi, L.; Weiss, A.H. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A double labelling method (DLM) using ^{14}C-labelled hydrocarbons and deuterium gas simultaneously was developed to study the mechanism of consecutive reactions such as acetylene and diene hydrogenation. The method is capable of clarifying surface reaction routes and at the same time the adsorption/desorption behaviour of the reactant and intermediate. Based on this method the authors expect to answer questions arisen in earlier investigations of acetylene hydrogenation, where surface concentration of species were measured by using a flooding method. Surface reactions and adsorption/desorption in relation to parameters such as pressure, temperature and catalyst aging are discussed in detail.

2249 (INIS-mf—6528, pp 263-264) **Aromatic astatination reactions.** Vasaros, L.; Berei, K. (Koezponti Fizikai Kutato Intezet, Budapest (Hungary)); Norseyev, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Hot homolytic, thermal electrophilic and nucleophilic replacement reactions in liquid aromatic compounds of the type C_6H_5X (where X = H, F, Cl, Br, I, CH_3NH_2 and NO_2) by astatine were investigated. In these reactions astatine as a monovalent halogen atom is capable of replacing hydrogen and heavy groups of the aromatic substrates and forming stable C-At covalent bond. The mechanism of aromatic astatination reactions is discussed on the basis of the experimental results.

2250 **Comparison of laser excited fluorescence and photoacoustic limits of detection for static and flow cells.** Voigtman, E.; Jurgensen, A.; Winefordner, J.D. (Univ. of Florida, Gainesville). *Analytical Chemistry;* **53**: No. 12, 1921-1923(Oct 1981). Contract AS05-78EV06022 MOD AOOE.

The fluorescence and photoacoustic characteristics of a windowless flow cell intended for liquid chromatographic applications are compared with respective characteristics of a static cuvette cell. In addition, a photoionization mode of operation for the flow cell is exhibited which utilizes the ionization products of two-photon excitation of polynuclear aromatic hydrocarbons in n-alkanes to effect a sensitive detection of those PAHs.

2251 **Physicochemical behavior of PAH in coal conversion liquid effluents.** Walters, R.W.; Luthy, R.G. (Carnegie-Mellon Univ., Pittsburgh, PA). pp 539-550 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The work described in this paper focuses on understanding the source, nature, and fate of PAH in coal conversion wastewater samples. Wastewater samples from a coke plant and from a gasification pilot plant have been separated into liquid and suspended solid phases by filtration, and the PAH associated with each phase have been characterized with regard to molecular weight, aqueous solubility and carcinogenic potential. (KRM)

2252 **Studies of the interaction of polycyclic aromatic hydrocarbons with fly ash.** Griest, W.H.; Caton, J.E. (Oak Ridge National Lab., TN). pp 719-730 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981). Contract W-7405-ENG-26.

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

Coal fly ash exhibits strong sorption for PAH but the mechanism of the strong sorption phenomonon must be understood to develop more efficient extraction procedures for quantitative analysis. This paper reports further studies of PAH sorption by coal fly ash. The results indicate that the PAH sorptivity of fly ash appears to result from a more complex cause than just carbon content. The form of the carbon and nitrogen content may be important also. (KRM)

2253 **Attempt to investigate the influence of the chemical binding on the total mass absorption coefficient of gamma quanta with the Moessbauer effect.** Bonchev, T.; Statev, S.; Benova, E. (Sofia Univ. (Bulgaria). Katedra po Atomna Fizika). *Nuclear Instruments and Methods;* **173**: No. 3, 609-611(Jul 1980).

An attempt to investigate the influence of the chemical binding on the total mass absorption coefficient (μ/rho)sub(t), as predicted by a number of authors, is performed. The absorption coefficient is determined for the recoilless part of the resonance gamma radiation of ^{119}Snsup(i). This permits total elimination of the background and considerable increase of the accuracy of measurement as compared to the other existing methods.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 2272, 2274

2254 (INIS-mf—6528, pp 255-258) **Some electrochemical applications of Moessbauer spectroscopy.** Vertes, A.; Nagy, K. (Eoetvoes Lorand Tudomanyegyetem, Budapest (Hungary). Fizikai Kemiai es Radiologiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Tin-nickel alloys were electrodeposited on the surface of copper. The Moessbauer phase analysis of the electro-formed layer identified Ni-Sn, elemental Sn and Sn-Cu alloy components. The ratio of the amounts of the detected components was the function of the tin and nickel concentration in the electroplating solution. The structure of the tin film cemented on aluminium substrate has also been investigated. The most intensive connection between tin and aluminium was observed in the case of aluminium alloyed by 17% silicon. Copper was electro-deposited on tin connected on aluminium substrate. The copper was alloyed by the tin.

4005 Photochemistry

REFER ALSO TO CITATION(S) 2265, 2268, 2508, 2516, 2566

2255 **High pressure study of viscosity and temperature effects on tetracyanobenzene EDA complexes.** Thomas, M.M.; Drickamer, H.G. (School of Chemical Sciences and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Journal of Chemical Physics;* **75**: No. 11, 5246-5249(1 Dec 1981).

High pressure fluorescence studies from 0—10 kbar have been performed on electron donor—acceptor (EDA) complexes of s-tetracyanobenzene (TCNB) with a series of aromatic hydrocarbons. Four solvents were used: 2,2,4,4,6,8,8-heptamethylnonane

(HMN), methylcyclohexane (MCH), 2,6,10,14-tetramethylpentadecane (TMPD), and a mixture of MCH and HMN. A viscosity range from 0.006 to 10 000 P was covered at two temperatures: 0 and 25 °C. As pressure (viscosity) increased the fluorescence spectrum shifted from one dominated by emission from the equilibrium (EQ) excited singlet state to one dominated by Franck—Condon (FC) singlet emission. Lifetime measurements for the complexes of o-xylene and p-xylene with TCNB yielded the two radiative rates (k/sub EQ/ and k/sub FC/) as well as the rate of relaxation from FC to the EQ excited state (k/sub RE/). k/sub RE/ was found to correlate well with viscosity and to be independent of temperature at constant viscosity, indicating that the relaxation process is diffusion controlled.

4006 Radiation Chemistry

2256 (INIS-mf—6528, pp 18-21) **Effect of radiosterilization on the basic properties of some sup(99m)Tc labelled pharmaceuticals.** Booc, A.; Toerkoe, J. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Some heat-sensitive radiopharmaceuticals - stannous complexes for labelling with technetium-99m were sterilized finally with cobalt-60 gamma irradiation in the Institute of Isotopes of the Hungarian Academy of Sciences. To prove the usefulness of radiosterilization the basic properties of irradiated and non-irradiated samples (solubility, colour, chemical changes, biological behaviour) were compared. The chemical changes were followed by thin-layer chromatography, gel-filtration and IR spectra, while the biological behaviour was tested by organ distribution studies in rats. The experimental results suggested that stannous complexes investigated may be radiosterilized in dry state with 25-30 kGy dose without any considerable degradation.

2257 (INIS-mf—6528, pp 26-29) **Radiation chemical processes treated by Monte Carlo technique.** Botar, L.; Vidoczy, T. (Magyar Tudomanyos Akademia Koezponti Kemiai Kutato Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Chemical reactions in irradiated systems are simulated by random walk with annihilating interactions. The solvent is supposed to be a continuous medium. The initial spatial distribution of radicals in spurs as well as the direction and length of displacements of reacting species are generated by Monte Carlo technique. The dependence of calculated molecular yields on the cube root of scavenger concentration is fairly linear, in agreement with experimental data.

2258 (INIS-mf—6528, pp 62-65) **Application of stable nitroxyl radicals in radiation-chemical investigations.** Hardy, G. (Magyar Tudomanyos Akademia Koezponti Kemiai Kutato Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The paper deals with the reactions of stable nitroxyl radicals of imidazoline and piperidine types with different short living radicals formed during gamma-irradiation of aqueous and non-aqueous solutions. It is proved that nitroxyl radicals do not react with peroxide-type radicals. They react in different ways with reducing and oxidizing particles.

2259 (INIS-mf—6528, pp 118-121) **Investigation of the radiation-chemical oxidation of toluene in organic phase.** Kovacs, L. (Magyar Tudomanyos Akademia Koezponti Kemiai Kutato Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The process of radiation-induced oxidation of toluene at room temperature in the presence of different radical acceptors has been studied. It was shown that most of the oxidized products are formed by radical mechanism while other products (creosols, one part of benzylhydroperoxide) are produced by different ways, because their radiation-chemical yields do not change under the effect of radical acceptors. The minimum possible reaction mechanism for the formation of end-products is described.

2260 (INIS-mf—6528, pp 134-137) **Radiation oxidation of the water solution of toluene. Investigation of H_2O_2-ROOH formation.** Kroo, E. (Magyar Tudomanyos Akademia Koezponti Kemiai Kutato Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The radiation oxidation of toluene in water solution saturated with air, N_2O and Ar was investigated. Organic hydroperoxide was not detected. H_2O_2 addition to the system had a great influence on the accumulation rate of dimers and on the hydrogen peroxide itself. This fact indicates that hydrogen peroxide takes part in the reaction. The reaction rate is also discussed.

2261 (INIS-mf—6528, pp 167-170) **Radiolytic oxidation of p-xylene and its derivatives in aqueous solutions.** Matus, L. (Magyar Tudomanyos Akademia Koezponti Kemiai Kutato Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

^{60}Co γ-ray-initiated oxidation of p-xylene, p-methyl-benzyl-alcohol, p-tolualdehyde and p-xylene hydroperoxide has been studied in water-solution. Because of the low concentration of the alkyl-aromatic hydrocarbons, no direct effect of radiation was considered, only the reactions of primary particles formed in the water had to be taken into account. The experiments in the solutions saturated with N_2O, as well as the reactions with OH radicals have been studied. The kinetics of the accumulation of oxidation products has been measured. The rate-constants of the OH radical with the examined compounds have been determined.

2262 (INIS-mf—6528, pp 296-299) **Pulse radiolysis in the nanosecundum range using alkenes as charge scavengers.** Cserep, G.. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The method of pulse radiolysis (1MeV/15 μsec electron beam) was used to study reaction intermediates in irradiated liquid alkanes, butylchloride and dioxane containing isolated and conjugated alkadienes. The positive and negative intermediate ions of alkadienes were detected by optical spectroscopy.

2263 (INIS-mf—6528, pp 300-303) **Recent results in the radiolysis of double-scavenged hydrocarbon systems.** Foeldiak, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

As a result of electron pulse radiolysis it was proved that radical scavengers in a ternary system of cyclohexane-iodine-galvinoxyl react not only with hydrocarbon radicals produced by irradiation but also with each other, thus, from the point of view of competition, the processes must be considered to be complex.

2264 (INIS-mf—6528, pp 312-314) **Liquid phase radiolysis of butylcyclopropane isomers.** Kovacs, A.; Bursicsne Szekeres, E.; Foeldiak, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The radiolysis of butylcyclopropane isomers is similar to that of butylcyclobutanes, while the radiolysis of alkylcycloalkanes with C_6 and a greater number of ring carbon atoms leads to aliphatic alkenes. Under irradiation a "simultaneous" splitting of two C-C bonds in butylcyclopropanes (and in the corresponding cyclobutane

derivatives) can frequently be observed, followed by radical and/or ionic reactions. The yield of C_7 products is lower, that of C_1-C_3 products is higher in case of butylcyclopropanes than the yield of C_8 and C_1-C_4 products in case of butylcyclobutanes, owing to the greater strain energy of the cyclopropane ring.

2265 (INIS-mf—6528, pp 315-318) **Comparison between radiolysis and photolysis of dimethylcyclohexanes.** Kozari, L.; Wojnarovits, L.; Foeldiak, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

With the aim of revealing relationships between the structure and decomposition product spectrum of liquid hydrocarbons the γ-radiolysis and the 7.6 eV photolysis of isomeric dimethylcyclohexanes were investigated and compared. While in the course of photolysis the products are mainly formed in monomolecular processes, in radiolysis the bimolecular processes dominate. The different product yield of individual DMCH isomers can be traced back to the different probabilities of their C-C bond scissions. In the ring-opening processes mainly straight-chained olefins are produced: their compositions are somewhat different in case of cis and trans isomers. It seems that the final products "remind" a little bit of the structure of the starting isomer.

2266 (INIS-mf—6528, pp 323-326) **Gamma irradiation induced transformation of 2-propanol on metal oxides.** Palfi, S.; Sarkany, A.; Tetenyi, P. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The catalytic decomposition of 2-propanol into acetone and propylene on TiO_2, V_2O_5, Cr_2O_3, MnO_3, Fe_2O_3, CoO, NiO, CuO and MnO_3 has been studied in the absence and in the presence of 70 kGy of gamma irradiation. Irradiation enhances the yield of 2-propanol transformation. Fragmentation of 2-propanol takes place, and in cases of TiO_2, V_2O_5 and Fe_2O_3 the selectivity of 2-propanol decomposition is shifted towards dehydration due to the irradiation. Both catalytic and radiocatalytic transformation of 2-propanol correlate with the adsorption capacity of the metal oxides, which suggests, that irradiation has an effect mainly on the adsorbed 2-propanol.

2267 (INIS-mf—6528, pp 327-330) **Transformation of cyclohexane on γ-irradiated Pt/γAl_2O_3 and Ni/MS-5A catalysts.** Szauer, G.; Gyoergy, I.; Foeldiak, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The γ-radiolysis of cyclohexane was studied in the presence of Pt/γ-Al_2O_3 and Ni/MS-5A (Molecular Sieve 5A) catalysts. Pulses of cyclohexane were led through the radiation field of ^{60}Co source and led into a gas-chromatograph using an argon stream. Unsaturated fragments produced in the argon-sensitized radiolysis of cyclohexane (mainly ethylene and propene) were observed to undergo "in situ" hydrogenation in presence of the catalysts, the most important products of the radiation/catalytic process being ethane, ethylene, propane and propene.

2268 (INIS-mf—6528, pp 331-334) **Simple method for approximating the kinetics of inhomogeneous chemical reactions in radiation and photochemistry.** Szondy, T.; Foeldiak, G.; Keszei, C. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The basic principles of a simple method are outlined which makes it possible to approximate the kinetics of the inhomogeneous chemical reactions encountered in radiation and photochemistry by mathematical tools formally identical with those used in homogeneous reaction kinetics. The method can be useful not only in refining the treatment of such reactions but also to obtain insight into the structure of the inhomogeneities.

2269 (INIS-mf—6528, pp 335-338) **Origin of structure effects in the radiolysis of alkanes.** Wojnarovits, L.; Foeldiak, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

While the overall yield of activated molecules decomposing by C-C or C-H bond rupture during radiolysis of liquid alkanes is approx. constant, G=6.5+-1, the ratio of primary C-C and C-H ruptures is highly structure dependent: in case of cyclohexane the ratio is 0.13, whereas for neopentane or 2,2,4-trimethyl-pentane it is 15 times higher. During 7.1-8.4 eV photolysis, when the decompositions originate mainly from the S_1 state, some molecules (e.g. cyclohexane) decompose solely by C-H, while others, the highly branched ones, nearly entirely by C-C bond ruptures. By comparing the product spectra, the $G(S_1)$-value is estimated to be 1.5-3, and the structure effect in radiolysis can be traced back first of all to the high selectivity of decomposition from the S_1 state.

2270 **Destruction of benzo[a]pyrene by gamma irradiation.** Baasel, W.D. (Ohio Univ., Athens); Allen, C.C. pp 159-168 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper deals with the problem of reducing the carcinogenic potential of combustion gases due to the presence of PAH, particularly benzo(a)pyrene (BaP). The chemical decomposition of solid PAH induced by radiation initially occurs relatively rapidly but then proceeds at a greatly reduced rate. Therefore, some of the barriers to the decomposition of PAH could be overcome if PAH were irradiated in the vapor phase prior to its adsorption onto particulate matter. This could be done if the PAH are irradiated in combustion effluents while they are still at elevated temperature (above 200°C). The present investigation documents the decomposition of BaP at elevated temperatures in the presence of cobalt-60 gamma radiation, and determines how fast these processes occur. (KRM)

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 1798, 1799, 2249, 2470, 2471

2271 (INIS-mf—6528, pp 12-13) **Phase effect on chemical reactions of ^{38}Cl.** Berei, K.; Vasaros, L. (Koezponti Fizikai Kutato Intezet, Budapest (Hungary)); Ache, H.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The effect of the physical and chemical properties of the medium on stabilization processes of recoil chlorine atoms produced via $^{37}Cl(n,\gamma)^{38}Cl$ nuclear reaction has been investigated in simple aliphatic and aromatic systems. Chemical reactivity towards thermalized chlorine atoms as well as phase transition and the long range order of the medium (crystalline vs glassy systems) was found to exhibit decisive influence on these processes. Finer details in the molecular order, however, e.g. differences in the molecular crystal structure, do not seem to play a significant role. Some conclusions could be drawn from these results on the relative contribution of thermal and hot reactions of ^{38}Cl to the formation of labelled organic compounds.

2272 (INIS-mf—6528, pp 14-17) **Electrolysis of radioactive substances at a mercury cathode.** Bolyos, A.; Madi, I. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Izotop Lab.); Duflo, M. (Institut du Radium, 75 - Paris (France). Lab. Curie). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The kinetics of electrolytic deposition of radioactive substances (^{64}Cu, ^{212}Pb, ^{65}Zn) on a mercury cathode was investigated as a function of the electrode potential. It was found that for each

potential an equilibrium state is reached between the radioactive substance deposited on the mercury cathode and left in the solution. The critical deposition potential was determined from the potential dependence of the amount deposited in the equilibrium state.

2273 (INIS-mf—6528, pp 122-125) **Yield from melted metals and gas-thermochromatographic separation of radionuclides produced by synchrocyclotron.** Kovacs, Z. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Gas-thermochromatographic separation of elements produced in targets irradiated by 660 MeV protons has been investigated. The purpose of the experiments was the determination of circumstances required for "on-line" production of short-lived neutron-deficient isotopes of certain elements. The optimum evaporation and separation of Re and Os from Au target melt, and that of Ru, Tc and Mo from Ag were determined.

2274 (INIS-mf—6528, pp 175-178) **Deposition of radioactive substances on a platinum anode.** Madi, I. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Izotop Lab.). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The kinetics of the deposition of radioactive substances (^{204}Tl, ^{144}Ce, ^{143}Pr, ^{166}Ho, ^{147}Nd, ^{242}Cm) on platinum anode was investigated. The critical deposition potential was determined from the potential dependence of the rate constant and the amount deposited in the equilibrium state. The surface structural properties of the electrode have an effect on electrolytic deposition and this is especially important for the electrolysis of radioactive substances present only in tracer quantities.

2275 (INIS-mf—6528, pp 236-238) **Radiochemical application of synthetic inorganic ion exchangers.** Szirtes, L.; Koernyei, J.; Zsinka, L. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Various inorganic ion exchangers were used to separate mother/daughter elements (^{99}Mo/sup(99m)Tc, ^{113}Sn/sup(113m)In and ^{131}Ba/^{131}Cs) as well as products of parallel nuclear reactions. They were successfully applied for strontium separation from waste water and in isotope generators.

2276 (INIS-mf—6528, pp 319-322) **Preparation of radioiodine-labelled prostaglandins and their metabolites.** Mucha, I.; Toth, G.; Tanacs, B. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The preparation of radioiodine-labelled prostaglandins (PG) for application in radioimmunoassay kits is presented. Using carboimide method PG was coupled to methyl-L-thyrosinate, then radioiodination was performed with Na^{125}I and the labelled products were separated on Sephadex LH-20 dextrane gel. The efficiency of separation is proved.

2277 **No-carrier-added bromination of estrogens with chloramine-T and Na^{77}Br.** Mazaitis, J.K.; Francis, B.E.; Eckelman, W.C.; Gibson, R.E.; Reba, R.C. (George Washington Univ., Washington, DC (USA)); Barnes, J.W.; Bentley, G.E.; Grant, P.M.; O'Brien, H.A. Jr. (Los Alamos Scientific Lab., NM (USA)). *Journal of Labelled Compounds and Radiopharmaceuticals;* **18**: No. 7, 1033-1038(Jul 1981).

The syntheses of monobromohexestrol and 17α-bromoethynylestradiol are described as examples of bromination of phenolic and ethynyl moieties using Chloramine-T. This technique represents a unique method of producing no-carrier-added radiobromoethynylderivatives. However, more efficient chromatography is needed to separate the chloroderivative, which is a side product of the reaction, from the radiobromoderivative.

2278 **Synthesis of 4-fluoro-2,3-dimethyl-1-phenyl-3-pyrazoline-5-one (4-fluoroantipyrine) and ^{18}F-labeled analog by direct fluorination of antipyrine with molecular fluorine.** Shiue, C.Y.; Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Labelled Compounds and Radiopharmaceuticals;* **18**: No. 7, 1059-1066(Jul 1981).

A facile procedure for preparing 4-fluoroantipyrine is reported. Treatment of antipyrine with molecular fluorine gives 4-fluoroantipyrine (3) and 4,4-difluoro-3-hydroxy-2,3-dimethyl-1-phenylpyrazolidin-5-one (2). The product distribution depends on the ratio of antipyrine and molecular fluorine. The same procedure is used to prepare [^{18}F]-4-fluoroantipyrine with high specific activity.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 2446

2279 (INIS-mf—6542, pp vp) **Application of metal vapor lasers to Raman spectroscopy for gas and flame diagnostics.** Glatt, I.; Smilanski, I.; Bar-Ziv, E. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2280 **Spatially resolved temperature profiles from atomic absorption at high spectral resolution.** Yeung, E.S.; Steenhoek, L.E.; Tong, W.G.; Bobbit, D.R. (Iowa State Univ., Ames). *Analytical Chemistry;* **53**: No. 12, 1936-1938(Oct 1981). Contract W-7405-ENG-82.

Spatially resolved temperature profiles are important in a broad range of chemical problems, including the proper design and utilization of atom sources for analytical spectrometry, the understanding of the dynamics of combustion, and the interpretation of thermodynamic data. Numerous methods (and variations thereof) for temperature measurements have been summarized previously. Without exception, these methods involve point-by-point measurements whenever spatial profiles are desired. This is not only time-consuming but may become impractical for transient events since the system must maintain its integrity over the entire set of measurements. Further complications exist when thermodynamic equilibrium is not established among the various degrees of freedom, since most of these methods can only effectively determine one particular type of temperature. In this paper, we report a scheme that can efficiently provide spatially resolved temperature profiles in a remote-monitoring configuration. This is based on introducing a small amount of atoms into the system as a probe, so that spectral profiles of atomic absorption, spatially resolved using a vidicon can be used to determine the temperature.

42 ENGINEERING

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 3123, 3124

2281 **(GEND—011) Canister-design considerations for packaging of TMI Unit 2 damaged fuel and debris.** Townes, G.A. (EG and G Idaho, Inc., Idaho Falls (USA); Allied-General Nuclear Services, Barnwell, SC (USA)). Sep 1981. Contract AC07-76ID01570. 91p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE82000885.

This report presents the results of a study performed to examine the means of packaging the failed fuel from the TMI-2 reactor core and to provide conceptual canister-design. The report presents a conceptual fuel canister-design. Technical operations are considered to support the design. The TMI fuel when canned will be stored in the spent fuel storage pool. After a period of on-site storage, it is expected that the bulk of the fuel will be shipped off-site for either extended storage or possibly, chemical reprocessing. The final disposition of this fuel, as is common to the expectations for all spent high-level nuclear waste, is geological burial. Evaluation is made of the technical, economic, and institutional factors as-

sociated with alternate approaches to canning of this fuel. A single, multi-application canister is developed into a detailed concept design. Both square and round cross section alternatives are presented. Recommendations are presented concerning other future deve microsampling technique for carrying out exact measurements within the radial temperature gradient.

2282 (IA—1356, pp 308-309) **Flowrate calibration of the Tabgha pumping station of the Israel National Water Carrier.** Lewis, S.; Bar-Sela, Y. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2283 (INIS-mf—6528, pp 163-166) **Facilities and equipment for processing beta emitters.** Mangliar, F.; Mandli, J.; Gaspar, I. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

MM-1 and MM-2 type lucite desk-top boxes were constructed for various manipulations with beta emitters. The equipment is simple and can be decontaminated easily. As an example of application the generation of radioactive light sources from promethium oxide of 9.25 TBq (250 Ci) total activity is given.

2284 (INIS-mf—6542, pp vp) **Flash X-ray system with 0.5mm source size tube.** Segalov, Z.; Carmel, Y.; Eylon, S.; Ginzburg, A.; Goren, Y. (Government of Israel Scientific Department, Haifa, Israel). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2285 (INIS-mf—6542, pp vp) **Ultrasonic method for the evaluation of multiphase binary diffusion.** Ronen, Z.; Rokhlin, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)); Dariel, M.P. (Ben-Gurion Univ. of the Negev, Beersheba (Israel); Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2286 (JINR-R—18-12147, pp 347-351) **Development of the basic elements of cryogenic systems.** Pron'ko, V.G.; Krakovski, B.D. 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

Using the KGU-1600/4.5 cryogenic helium plant with a liquid helium circulation unit as an example, possibilities of perfecting flowsheets of cryogenic devices are shown. The design capacity of the KGU-1600/4.5 plant is 1750 W at 3.8 K with simultaneous production of 45 l of liquid helium per hour. The specific energy consumption with consideration for the cold equivalent to liquefiable helium constitutes about 280 W/W at an increased reliability of operation. Hign characteristics have been obtained due to the use of a new thermal cycle which approximates the reverse one. The cycle has been improved by introducing an isentropic compression of cooling agent vapours. The increase of the number of turbine expanders from 2 to 3 has raised the cycle efficiency by 10% and considerably facilitated their operating conditions, i.e. reliability.

2287 (JINR-R—18-12147, pp 153-163) **Nuclear filters.** Zamyatnin, Yu.S. 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

General problems pertaining to production and usage of millipore or nuclear filters are presented. Production of nuclear filter pores is based on different rates of etching of an initial polymer and its parts which have been subjected to radiation destruction under the action of accelerated heavy ions. Basing on the results of experiments carried out on a heavy ion cyclotron, a conclusion has been drawn that the most suitable for irradiation of films are xenon ions (Xe^{6+}) with an energy of 150 MeV having a value of $dE/dx = 80$ MeV/mg/cm^2, and also ions MeV/mg/cm^2 of argon Ar^{6+}. As an irradiated polymer material use was of lavsan (dacron). For water the filter capacity constituted 1 m^3/m^{2}xh at the pore diameter $d = 0.1$ μm, and 100m^3/m^{2}xh at $d = 1$ μm. For air the capacity proved to be 200-300 times higher. Wide possibilities of application of nuclear filters for, primarily, the processes of fine refinement, separation and concentration of various products, both liquid and gaseous, are shown.

2288 (KFTI—79-26, pp 3-22) **1. Pt. Physics and technoloy of vacuum (1971-1977).** Miroshnichenko, R.K.; Khasin, I.Z. (comps.). 1979. (In Russian). Dep. NTIS (US Sales Only).

In Bibliographic index on vacuum and superconductivity (1971-1977), published in collection "Problems of nuclear science and technology".

Bibliographic index includes 185 papers, dealing with the problems of vacuum physics and technology published in 1971-1977 in collection "Problems of nuclear science and technology". Arrangement of the materials in the index is systematized by the following sections: 1) General problems of physics and technology of vacuum. 2) Processes in vacuum. 3) physics of cryogenic vacuum. 4) Cryogenic means of vacuum production and maintainance. 5) Cryogenic supply. 6) Noncryogenic means of vacuum production. 7) Components and assemblies of vacuum systems. 8) Vacuum application in technological devices and physical apparatus. Within each section the material is arranged in the alphabetic order. The issue is provided with a list of authors and chronology.

2289 (KFTI—80-6, pp 62-63) **Autonomous liquid hydrogen target.** Nichinskii, N.A.; Stanik, A.M.; Shevtsov, S.V. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

An autonomous liquid hydrogen target design on the base of the ChM-20B microrefrigerator intended for experiments of pion photoproduction at γ-quanta energy of about 1 GeV is described. The experiments on hydrogen liquefaction were carried out with the operating volumes made of duralumin and oxygen-free copper. In the first case during 5 h operation 20 cm^3 of liquid hydrogen were obtained; in the second case after 1.5 h operation 60 cm^3 of the cooling agent were condensed. The facility developed may also be applied to cooling systems in various devices of low cooling agent productivity when existence of the liquid phase of a cooling agent as a stabilizing temperature factor turns out to be efficient.

2290 **Thermal activation model for noise in DC SQUID.** Tesche, C.D. (LuTech, Inc., P.O. Box 1263, Berkeley, California). *Journal of Low Temperature Physics;* **44**: No. 1, 119-161(1 Jul 1981).

A thermal activation model is described for the dc SQUID. The equations of motion for the junction phase differences are shown to develop in time like the coordinates of a particle performing Brownian motion in a viscous medium in a two-dimensional potential field. Expressions are derived relating the average voltage, transfer function, and current and voltage noise spectral densities to the features of the potential determined by the device parameters. Comparison with a numerical simulation is presented. Calculations of the current noise as a function of loop inductance and critical current asymmetry are performed. An anomalously large current noise is predicted at certain values of the device characteristics. The correlation spectral density is also calculated as a function of loop inductance, and related to the optimal source resistance for a tuned SQUID amplifier. A theory of low-frequency noise sources in the SQUID is developed in a fashion compatible with the thermal activation model. Equilibrium temperature fluctuations as a possible source of 1/f noise in the SQUID are discussed. A scheme for optimizing the resolution at low frequencies is presented. Proper exploitation of low-capacitance Pb—PbO—Pb junction technology is shown to increase the resolution at 1 Hz by at least a factor of 8, provided that the temperature fluctuations are the dominant source of noise.

2291 **Thermoelectric generation of charge imbalance at a superconductor-normal metal interface.** Van Harlingen, D.J. (Department of Physics, University of California, and Materials and Molecular Resarch Division, Lawrence Berkeley Laboratory, Berkeley, California). *Journal of Low Temperature Physics;* **44**: No. 1, 163-176(1 Jul 1981).

The thermoelectric voltage produced across a superconductor—normal—metal—superconductor (SNS) sandwich by an applied heat current has been measured in Pb—Cu—PbBi and In—Al—Sn as a function of temperature. The observed divergence of the thermoelectric voltage near T/sub c/ is attributed to a charge imbalance region decaying into the superconductor from the NS interface over the quasiparticle diffusion length λ/sub Q/ +- . The charge imbalance is generated by thermoelectrically driven quasiparticle currents in the super-conductor. It contributes a voltage per unit heat power given by V/sub s//P = λ/sub Q/ +- S//sub kappa/A, where A is the sample cross-sectional area, and S and κ are the thermopower and the thermal conductivity of quasiparticles in the super conductor. For Pb and In, we find the measured thermopower in the super-conducting state to be slowly varying with temperature near T/sub c/ and consistent in magnitude with normal state values. This results is in agreement with theoretical predictions of thermoelectric effects in superconductors but contrary to previous experimental results obtained by other methods.

4203 Lasers

2292 (INIS-mf—6542, pp vp) **Transverse-mode matching in unstable-resonator injection-locking.** Kedmi, Y.; Treves, D. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Electronics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2293 (INIS-mf—6542, pp vp) **Kinetic investigation of the upper laser levels of the copper vapor laser lines.** Tenenbaum, J.; Smilanski, I.; Lavi, S. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2294 (INIS-mf—6542, pp vp) **Preionization effect on a copper vapor laser.** Gabay, S.; Smilanski, I. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2295 (INIS-mf—6542, pp vp) **Investigation of longitudinal pumping of dye lasers by a copper vapor laser.** Amit, M.; Lavi, S.; Miron, E.; Erez, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2296 (INIS-mf—6542, pp vp) **Novel beam quality measurement technique and parametric study of an unstable resonator copper vapor laser.** Lavi, S.; Gabay, S.; Miron, E.; Erez, G.; Smilanski, I. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2985, 2986

2297 **Constitutive laws of 1-D, two-fluid, two-phase flow models: possible mathematical forms, restrictions resulting from basic principles.** Boure, J.A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Transferts Thermiques). pp 5-16 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 1. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

From both the theoretical and the practical points of view, the problem of constitutive laws is part and parcel of the modeling problem. In particular, the necessity to restore in the model, through topological laws, some of the information lost during the usual averaging process is emphasized. A new void fraction topological law is proposed. The limitations of the current assumption of uniform pressure within each phase in any cross section are also illustrated. The importance of proximity effects (neighborhood and history effects, related to characteristic lengths and times) is brought out. It results in the importance of the mathematical form of the constitutive laws. Possible mathematical forms for the transfer laws are reviewed. The last part of the paper is devoted to some restrictions, which are imposed on the transfer terms because of some basic principles: Indifference to Galilean changes of frame and to some changes of origins, second law of thermodynamics and hypothesis of local thermodynamic equilibrium, closure constraints. Practical recommendations are formulated.

2298 **Some aspects of two-fluid models for two-phase flow and their numerical solution.** Agee, L.J.; Duffey, R.B. (Electric Power Research Inst., Palo Alto, CA (USA)); Hughes, E.D. (Energy, Inc., Idaho Falls, ID (USA)); Banerjee, S. (McMaster Univ., Hamilton, Ontario (Canada)). pp 27-58 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 1. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

In this paper, we derive a set of one-dimensional two-fluid equations for unequal phase velocities, unequal temperatures and unequal pressures. These equations represent an intermediate step in the process of developing advanced analytical models for transient flow boiling. However, they are probably the most complete set for which we can at present obtain a set of constitutive equations based on physical considerations. They represent a first step in the development process towards obtaining improved two-fluid models.

2299 **Equations for transient flow-boiling in a duct.** Mathers, W.G.; Ferch, R.L.; Hancox, W.T.; McDonald, B.H. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). pp 59-82 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 1. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

In this paper we derive a separated phase model for weakly coupled flows which extends a model presented elsewhere (BANERJEE, FERCH, MATHERS and McDONALD, 1978). A hyperbolic system of seven partial differential equations results with ensemble-averaged phase velocities, enthalpies and pressures, and void fraction as dependent variables (UVUTUP model). The required constitutive equations for mass, momentum and energy transfer between phases and between the phases and the boundaries are discussed. The relationship of the UVUTUP model to other existing models is also presented.

2300 **Assessment of a drift-flux approximation for a strongly transient two-phase flow.** Moesinger, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). pp 129-147 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 1. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

The paper investigates the applicability of a drift-flux approximation for calculations of strongly transient two-phase flows in advanced computer codes. For this purpose a blowdown problem of a one-sided closed duct was calculated using three different methods: an ordinary drift-flux approximation; a refined drift-flux approximation; a six-equation model. A sixth differential equation for the relative velocity is derived. This differential equation will be simplified leading to both drift-flux approximations. The result of all three methods are compared and discussed.

2301 **Non-equilibrium mass transfer between liquid and vapour phases during depressurization processes.** Wolfert, K.; Burwell, M.J.; Enix, D. pp 149-190 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 1. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

This paper presents the results of a study, performed within the framework of the developmental verification of the advanced blowdown code DRUFAN, to determine the effect of the mass transfer across the liquid-vapour interface on relevant fluid dynamic parameters in simulating depressurization processes. In order to quantify the influence of the interfacial mass transfer a series of calculations with varied mass transfer rates were performed.

2302 **Development of the bubble rise model in RELAP-UK.** Holmes, J.A. (UKAEA Atomic Energy Establishment, Winfrith). pp 221-241 of Transient two-phase flow. Proceedings of the second CSNI specialists meeting, Paris, 12-14 June 1978. Vol. 1. Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (Feb 1981).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

Several improvements have been made to the 'bubble rise calculation' in the code RELAP-UK, which models the separation of the steam and water phases within specified volumes of the coolant circuit. The bubble rise velocity and the bubble density gradient parameter are no longer necessarily user-defined constants, as the code can calculate their values at each time step according to the local fluid conditions. In particular, the calculation of the bubble rise velocity is consistent with the RELAP-UK drift flux correlation. It is now possible to represent a vertical column by a stack of vertically-adjacent bubble-rise volumes. Any mixture level existing within the column can freely pass between the volumes in the stack. These facilities are demonstrated in this paper by a simple computational example involving phase separation within a closed vertical cylinder, and by simulation of a blowdown experiment performed in a glass vessel.

2303 **Transition from natural-convection-controlled freezing to conduction-controlled freezing.** Sparrow, E.M.; Ramsey, J.W.; Harris, J.S. (Department of Mechanical Engineering, University of Minnesota, Minneapolis, Minn. 55455). *Journal of Heat Transfer;* **103**: No. 1, 7-12(Feb 1981).

Experiments were performed to study the transition between freezing controlled by natural convection in the liquid adjacent to a freezing interface and freezing controlled by heat conduction in the solidified material. The freezing took place on a cooled vertical tube immersed in an initially superheated liquid contained in an adiabatic-walled vessel. At early and intermediate times, temperature differences throughout the liquid induce a vigorous natural convection motion which retards freezing, but the temperature differences diminish with time and natural convection ebbs. At large times, the freezing rate is fully controlled by heat conduction in the solidified material. The frozen specimens for short and intermediate freezing times are smooth-surfaced and tapered, while those for large times are straight-sided and have surfaces that are overlaid with a thicket of large discrete crystals. These characteristics correspond respectively to those of natural-convection- controlled freezing and conduction-controlled freezing. At early times, the measured mass of the frozen material is identical to that for natural-convection-controlled freezing and conduction-controlled freezing. At early times, the measured mass of the frozen material is identical to that for natural-convection-controlled freezing. At later times, the frozen mass tends to approach that for conduction-controlled freezing, but a residual deficit remains.

2304 **Effective thermal conductivity for combined radiation and free convection in an optically thick heated fluid layer.** Epstein, M.; Cheung, F.B.; Chawla, T.C.; Hauser, G.M. (Reactor Analysis and Safety Divsion, Argonne National Laboratory, Argonne, Ill. 60439). *Journal of Heat Transfer;* **103**: No. 1, 114-120(Feb 1981).

The effective thermal conductivity for radiative heat transfer within an optically thick fluid layer undergoing high Rayleigh number convection is derived. This result is combined with available "pure" free-convection heat-transfer correlations to obtain closed-form analytical descriptions of the gross properties of a radiating fluid layer heated internally or form below. These simple solutions compare favorably with recent work in which the governing energy equation incorporating both turbulant heat transport and thermal radiation is solved numerically.

2305 **Transient two-phase flow.** Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (1981). vp. (CONF-780659—(Vol.2)).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

Separate abstracts are presented for each of the conference papers included in the data base.

2306 **Proceedings of the fourth national heat and mass transfer conference 1977.** Meerut, India; Sarita Prakashan (1977). vp. (CONF-7711152—).

From 4. national heat and mass transfer conference; Roorkee, India (21 Nov 1977).

Separate abstracts are presented for each of the conference papers included in the data base.

4205 Materials Testing

2307 **Construction of a macro element for use in three dimensional fracture mechanics.** Hall, C. (Pittsburgh Univ., PA (USA). Inst. for Computational Mathematics and Applications). pp 69-81 of Polynomial and spline approximation. Theory and applications. Sahney, B.N. (ed.). Dordrecht, Netherlands; Reidel (1979).

From NATO Advanced Study Institute; Calgary, Canada (26 Aug 1978).

The stiffness derivative technique is used to compute stress intensity factors. The crack region is modelled by means of a macro element which contains, a priori, a high density of nodes in the vicinity of the crack front and is compatible with standard 20 node elements that it abutts.

4208 Electronic Circuits And Devices

2308 **Gallium phosphide high-temperature bipolar junction transistor.** Zipperian, T.E.; Dawson, L.R. (Sandia National Laboratories Albuquerque, New Mexico 87185). *Applied Physics Letters;* **39**: No. 11, 895-897(1 Dec 1981).

Transistor action at temperatures from 20 to 450 °C has been demonstrated for $p^+n^-pp^+$ bipolar structures fabricated in GaP. Improvements in the materials technology were essential to successful fabrication of these devices. The structural configuration chosen could also be used as a junction field-effect transistor although this mode of operation was limited by the initial design to lower operating temperatures. While present device characteristics are restricted by ohmic contact resistance, this does not appear to

be a fundamental limitation. These results demonstrate that GaP is a good materials candidate in which to base a technology for active electronic components operated at high temperatures.

2309 **Improved 50 ps photodiode.** Ramsey, J.M.; Whitten, W.B. (Analytical Chemistry Division, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37830). *Review of Scientific Instruments;* **52**: No. 11, 1657-1659(Nov 1981).

The construction of an inexpensive 50-ps rise-time photodiode is discussed. The temporal response of the photodiode is made insensitive to the quality of focus of the incoming light through a relatively simple procedure. Quantum efficiencies of up to 5.9% at 514 nm were measured.

2310 **Measurement of very small phase differences.** Schauer, F. (Brookhaven National Laboratory, Associated Universities, Inc., Upton, New York 11973). *Review of Scientific Instruments;* **52**: No. 11, 1776-1777(Nov 1981).

A simple method is presented to measure very small phase differences in the range of microradians between two ac voltages. The voltages are combined linearly and one of them is adjusted in amplitude such that the output is a minimum. This minimum voltage is proportional to the phase shift to be measured. The method is applicable from power to radio frequencies.

4209 Waste Processing Plants And Equipment

2311 **Transient two-phase flow.** Reocreux, M.; Katz, G. (eds.). Paris, France; Commissariat a l'Energie Atomique (1981). vp. (CONF-780659—(Vol.1)).

From Meeting on transient two-phase flow; Paris, France (12 Jun 1978).

Separate abstracts are presented for each of the conference papers included in the data base.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 2089

2312 **(DOE/ET/17091—T2) Electrocyclone development program. Quarterly technical report, February-April 1981.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 1981. Contract AC21-80ET17091. 43p. (FE—7091-10). NTIS, PC A03/MF A01. Order Number DE81025062.

In response to the need for a high efficiency, high throughput gas cleanup device for pressurized fluidized bed application, General Electric has experimented with an electrostatically augmented cyclone. A principal advantage of the GE Electrocyclone concept is that a 12-ft dia unit can be built with performance comparable to a 10-in. conventional cyclone. The use of large Electrocyclones will avoid the plugging and flow imbalance problems which have plagued the use of multi-clones. The development work is being continued under the present Electrocyclone Development Program. The Electrocyclone Development Program addresses three critical development areas: performance scaleup; performance at high temperature and pressure; and corona charging. The scaleup of Electrocyclone performance will be demonstrated experimentally by cold-flow testing of a 36-in. dia unit geometrically similar to the earlier 18-in. model. The performance at high temperature and pressure will be demonstrated byed was demonstrated which precluded the need for bed material removal prior to start-up as other investigators have found. Temperature distribution over the full bed height during design point and off-design operation was uniform and there was no indication of freeboard combustion. SO_2 aour at x approximately 0 up to 250 GeV/c.

4240 Pollution Control Equipment

2313 **Microcontroller for exhaust-stack environmental measurements.** Ethridge, C.D.; Littlefield, L.G. (Los Alamos Scientific Lab., NM). *Compcon Fall;* 122-127(Sep 1979).

The Exhaust-Stack Particulate Sampler Microcomputer-Controlled Data Acquisition, Calculation, and Display System has been developed to provide the operator with continuous sampling information as particulate samples are taken. Data inputs to the microcomputer system are provided by sensors measuring temperatures, pressures, humidity, and velocity of a stack flowstream. The microcomputer system incorporates a single component microcomputer, a number-oriented microprocessor, a single-chip 16-channel analog-to-digital converter, a programmable keyboard/display interface, and liquid crystal displays. The scientific calculation capability and associated display have been incorporated to perform and display the results of 28 complex equations. These results allow the operator to maintain proper sampler probe temperatures, to maintain proper flow through the sampler probe, and to make sampler probe positional changes when necessary.

43 PARTICLE ACCELERATORS

2314 (ZfK—430(Vol.1), pp 227-236) **New Saturne synchrotron and the Mimas project.** Radvanyi, P.; Ropert, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1980. Dep. NTIS (US Sales Only).

From International conference on extreme states in nuclear systems; Dresden, German Democratic Republic (4 Feb 1980).

The new Saturne of the Saturne National Laboratory at Gif sur Yvette is presented. The most important characteristics and physical data are reported. Some future intentions especially concerning a new injector for polarized particles and heavy ions, called Mimas, are treated.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 2348

2315 (JINR-D—9-12965, pp 162-180) **Construction problems of high-current ion linear accelerators.** Kapchinskii, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1979. (In Russian). Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

The basic parameters of high-current ion linear accelerators (LA) which are resonance accelerators with hundred-milliampere average current of beam are considered. The factors are considered affecting the limiting current of an ion beam in LA, as well as main engineering difficulties arising from them. It is emphasized that at present the best type of high current LA remains the Alvarez accelerator where sources of accelerating and focusing forces are separated. A conclusion is drawn that usage of sections with spatially homogeneous focusing in the initial part and magnetic hard quadrupoles in the basic part, makes it possible to improve considerably the design and electrical parameters of high current LA. It may be expected that in the nearest future, the efficiency of HF generators will amount to 70-80%, and in this case the total efficiency of short wave LA with 100 mA current of continuous beam will be 50-60%.

2316 (JINR-D—9-12965, pp 251-275) **Collective effects during particle acceleration.** Kolomenskii, A.A. (AN SSSR, Moscow. Fizicheskij Inst.). 1979. (In Russian). Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

Collective effects in cyclic accelerators of charged particles (synchrotrons and storage rings) are discussed. Considered are the character and degree of disturbance by space charge of transverse and longitudinal motions, shifts of betatron oscillation frequencies under the action of beam space charge, transverse and longitudinal instabilities of betatron oscillations. It is noted that collective effects restrict beam intensity and deteriorate such of its characteristics as emittance and monochromaticity.

2317 (JINR-D—9-12965, pp 276-299) **Heavy ion acceleration in synchrotrons.** Shukeilo, I.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

Physical and technological problems of synchrotron accelerator of heavy ions are discussed, viz. ion stripping, ion losses in charge exchange on residual gas, factors affecting the beam intensity. A diagram and basic parameters for the project of the heavy-ion accelerating complex are given. The methods for increasing pulse intensity of accelerating ion beam in such complexes are outlined. It is emphasized that the discussed approach to the problem of storage and synchrotron acceleration of heavy ions is a new illustration of wide possibilities which present the fundamental principles of charged particle acceleration, viz. strong focusing and autophasing.

2318 (KFTI—79-43, pp 31) **Measurement of the proton beam emittance in an accelerator with alternating-phase focusing.** Gusev, E.V.; Demchenko, P.A.; Koval'chuk, I.K.; Khizhnyak, N.A.; Shulika, N.G. 1979. (In Russian). Dep. NTIS (US Sales Only).

From 6. all-union seminar on linear accelerators; Kharkov, Ukrainian SSR (5 Jun 1979).

2319 (KFTI—79-57, pp 75-76) **Particle phase separation in resonators with Esub(ono) oscillation.** Knyazev, B.R. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Physical experiment technique.

The problem of electron phase separation in a resonator with the Esub(ono)-type oscillations is considered in the process of injection of particle bunch with the phase length of +-2 Δphi and entry phase phisub(0)+-Δphi into the resonator. Calculation data for the transverse deviation, velocity and divergencies of electrons at the resonator-separator out-let are given. The calculations showed the possibility of separation of short bunches with the phase length $\Delta phi < 1$ deg, having small values of these parameters.

2320 **Compression of an intense space-charge-neutral ion beam by an axial magnetic field.** Robertson, S. (Physics Department, University of California, Irvine, California 92717). *Applied Physics Letters;* **39**: No. 11, 883-885(1 Dec 1981).

An intense, space-charge-neutral beam of protons (150 kV, 15 A/cm^2) has been compressed from an initial diameter of 15 cm to a final diameter of 5 cm by propagating it along a magnetic field increasing from zero to 700 G in a distance of 55 cm. At the field maximum, the beam intensity is increased by a factor of 4 over the value with no field. When viewed from the beam frame, the experiment is analogous to a theta pinch with an applied field whose time derivative is v(dB/dx), where v is the beam velocity and dB/dx is the magnetic gradient. The surface of the beam moves radially inward at approximately the velocity predicted by the snowplow model.

2321 **Ion optics improvements to a multiple aperture ion source.** Gardner, W.L.; Whealton, J.H.; Barber, G.C.; Blue, C.W.; Dagenhart, W.K.; Haselton, H.H.; Kim, J.; Menon, M.M.; Ponte, N.S.; Ryan, P.M.; Schechter, D.E.; Stirling, W.L.; Tsai, C.C.; Wright, R.E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Review of Scientific Instruments;* **52**: No. 11, 1625-1628(Nov 1981).

Experimental comparison is made of four plasma grids, each with a specific aperture geometry, in an attempt to improve the ion optics of a multiple aperture ion source. It is clearly shown that a simple notch geometry outperforms the other candidates with a high transmission efficiency (~68%) to a 2° target at high perveance (~9.6 μperv).

2322 **Beam development at VEC.** Jain, A.; Bhandari, R.K.; Sethi, R.C.; Divatia, A.S.; Bose, D.K.; De, T.K.; Khemka, P.K.; Mukhopadhyay, B.; Mukhopadhyay, N.K.; Tiwari, S.D. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 316-318 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

In order to make the Variable Energy Cyclotron (VEC) operational in the shortest possible time after assembly, it was necessary to study the various parameters in advance. The parameters such as settings for the ion source and the puller, main coil current, trim and valley coil currents, radio-frequency and deflector settings for different energy protons and alphas have been calculated, and discussed in the light of operating experience. Beam current in the cyclotron has been studied as a function of the radius and the behaviour analysed. Possibilities of accelerating heavy ions with the VEC are discussed.

2323 **Magnetic field measurements on the VEC.** Bhandari, R.K.; Sethi, R.C.; Dasgupta, S.; Das, S.; Ghosh, D.K.; Gowariker, S.R.; Kainth, J.S.; Muralidharan, N.V.; Nair, K.R. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 332-335 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

Magnetic field measurements carried out in two phases on the Variable Energy Cyclotron (VEC) at Calcutta are described. In phase I, first harmonic contents of the VEC magnet are computed by plotting the difference signal produced by two matched search coils connected in opposite polarity. The integrated difference signal after attenuation is plotted on x-ray recorder. The plots are analysed for the amplitude and phase of the first harmonic. By adjusting the position of the ion source, the first harmonic is maintained at approximately 5 gauss. In phase II, detailed measurements on the magnetic field due to the main, trim and valley coils in the geometrical median plane of the magnet are made. Details of the procedure are given. Processing data was done on BESM-6 computer. The accuracies achieved are discussed.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 2674

2324 (JINR-D—9-12965, pp 5-24) **Main physical problems of superhigh energy accelerators.** Lapidus, L.I. 1979. (In Russian). Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

A survey is given of the state and prospects for the scientific researches to be carried out at the largest charged particle accelerators now under construction. The fundamental problems of the elementary particle physics are considered which can be solved on the base of experiments at high-energy accelerators. The problems to be solved involve development of the theory of various quark number, accurate determination of the charged and neutral intermediate vector boson masses in the Weinberg-Salam theory, the problem of production of t-quark, W^{-+} - and Z deg bosons, Higgs mesons and investigation of their interactions, examination of quark and lepton spectra, studies on the effects of strong interactions. As a result of the investigations on hadrons at maximum momentum transfers, the data on space-time structure at short distances can be obtained. It is emphasized that there are no engineering barriers to the construction of such accelerators. The main problem lies in financial investment. A conclusion is drawn that the next generation of accelerators will be developed on the base of cooperation between many countries.

2325 (JINR-D—9-12965, pp 25-55) **Prospects of studies with heavy ions and development of accelerating facilities in JINR.** Oganesyan, Yu.Ts. 1979. (In Russian). Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

Possibilities, main achievements and prospects for nuclear researches by means of heavy ions are considered. A riview is given of the fundamental investigation results which form a base of the cyclotron method for accelerating heavy ions. The basic parameters are listed for the designed complex, including the U-400, U-200 the accelerators and 2-nd stage (a cyclotron with separated sectors). It is emphasized that the problem of accelerating heavy ions for researches in nuclear physics and for wide range of investigations in adjacent regions (atomic physics, solid state, high-temperature plasma, radiochemistry, radiation material studies etc.) are in practice completely solved by development of such a complex.

2326 (JINR-D—9-12965, pp 99-111) **Superconducting magnets for isochronous cyclotrons.** Martin, E.R. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1979. Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

Different approaches using superconductivity for isochronous cyclotrons and examination of advantages and disadvantages of each of them are considered. The discussion is focused on isochronous cyclotrons designed for heavy particle acceleration up to kinetic energies of approximately 0.5 times the rest energy of the accelerated ion. A quantitative solution for the influence of the field edges and for the various values of the valley fields are given. The Indiana University cyclotron is considered where both the coil and the associated pole tip material operate at a cryogenic temperature. Offered are advantages for the design which provide reduction in size and impivement in terms of beam dynamics.

2327 (JINR-D—9-12965, pp 121-144) **Multicharged ion sources.** Venikov, N.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1979. (In Russian). Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

The main principles of action, beam parameters, basic problems and prospects for development of the available multicharged ion sources for various types of accelerators are considered. Descriptions of three types of Penneng sources (a source with coid cathodes, direct-heated source, and a source with a heated cathode), duoplasmatron, SHP source using electron-cyclotron resonance, electron-ray and laser sources are given. The problems productions for solid substance ions, lithium and beryllium ions in Penning sources, are considered as well as the problem of ion charge growth on passage of accelerated ion/or atom beam through a stripping target.

2328 (JINR-D—9-12965, pp 181-215) **Collective acceleration methods.** Sarantsev, V.P. 1979. (In Russian). Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

The basic trends in development, as well as specific features of collective methods of electron and ion acceleration, are diseussed. Examples of targets for electron and ion beams are given. The fundamental physical and engineering problems have been distingulished which confront the designers of autoresonance accelerators. Parameters of autoresonance accelerator sections are considered. A diagram and orbits of electron and ion motions in the collective accelerator of torroidal configuration are given. A conclusion is drawn that collective accelerators with electron rings have undergone all the stages of experiments of principle. The next stage is development of accelerators as tool for nuclear physics.

2329 (JINR-D—9-12965, pp 216-250) **Modern proton synchrotrons.** Myaeh, E.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1979. (In Russian). Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

The principles of design and certain important peculiarities in operation of modern large proton synchrotrons are discussed. The largest multicascade acceleration complexes and booster synchrotrons are considered. The problems of efficiency of the main processes in proton synchrotrons are discussed, as well as those of magnetic field correction. The main emphasis is placed on physical and engineering reasonic of the ways of developing accelerators nowadays.

2330 (KFTI—78-1, pp 68-70) **KFTI proton polarized target.** Derkach, A.Ya.; Karnaukhov, I.M.; Lukhanin, A.A.; Sorokin, P.V.; Sporov, E.A. 1978. (In Russian). Dep. NTIS (US Sales Only).

From Council of the Hadron Electromagnetic Interactions in the resonance energy region session; Kharkov, Ukrainian SSR (8 Jun 1977).

A proton polarized target with a superconducting magnet system is presented. The system consists of spheres with a diameter of 1.5 mm made of ethylene glycol with an impurity of ^{5}Cr paramagnetic complex. The spheres fill a fluoroplastic container which is positioned is an SHF resonator. The target dimensions are 20 x 20 x 20 mm. The results of investigations and development of basic functional systems of the polarized proton target are presented. The magnetic field of 3.61 T is produced by superconducting solenoids in the pseudo-Helmholtz geometry, which provide the study of reaction products in a wide range of angles and possess a greater design flexibility as compared with iron-core electromagnets. The polarization of target protons in a 2.7 T magnetic field at a temperature of 1 K constitutes 45%. The target utilizes the method of dynamic polarization of protons. The SHF-generator wave length is 4 mm. The proton polarized target is used in experiments aimed at studying cross-section asymmetries of the $\gamma p \rightarrow \pi^{+} n$ and $\gamma p \rightarrow \pi^{0} p$.

2331 (KFTI—78-1, pp 75-76) **Possibility of production of high-energy polarized photons.** Govorkov, B.B.; Lebedev, A.I.; Mangazeev, B.V. (AN SSSR, Moscow. Fizicheskij Inst.). 1978. (In Russian). Dep. NTIS (US Sales Only).

From Council of the Hadron Electromagnetic Interactions in the resonance energy region session; Kharkov, Ukrainian SSR (8 Jun 1977).

It is shown that polarization of bremsstrahlung photons of ultrarelativistic electrons witn respect to the plane of emission of secondary electrons is rather substantial within angles where intensity of bremsstrahlung is maximum. Polarization averaged over photon emission angles is calculated. For 1 GeV incident electron energies it reaches 50%. This phenomenon can be used to obtain linear-polarized high-energy monochromatic photons in labelling circuits provided that not only the energy but also the emission angle of the recoil electron are detected.

2332 (KFTI—78-1, pp 77-79) **Magnetic spectrometer with a streamer chamber for investigation of photo- and electronuclear processes in the 360 MeV linear electron accelerator ("Electron" installation).** Arkatov, Yu.M.; Vatset, P.I.; Voloshchuk, V.I.; Prokhorets, I.M.; Zolenko, V.A. 1978. (In Russian). Dep. NTIS (US Sales Only).

From Council of the Hadron Electromagnetic Interactions in the resonance energy region session; Kharkov, Ukrainian SSR (8 Jun 1977).

The results are given of investigations into operation of a steamer chamber filled with helium in a 11 kOe magnetic field and used to study electro- and photoprocesses. A purification system is used to provide repeated employment of a working gas. The chamber is surrounded with scintillation counters. Data on time and amplitude signal characteristics is used to trigger the pulse voltage generator. The reliability of basic units has been checked when triggered both by cosmic rays and in the magnetic field in a photon beam of a linear accelerator. The studies showed that the brightness and contrast of tracks from charged particles is sufficient to obtain photographs on a film with sensitivity of 1200-1500 GOST at a relative aperture of an objective equal to 8, that the spatial localization of tracks from charged particles in a magnetic field with a strength of up to 1 kOe remains, that the streamer chamber posesses a considerable multitrack efficiency which makes it possible

to use up to 10^8 real gamma-quanta per an accelerator pulse, and that visual identification of particles (products of a photonuclear reaction) is possible.

2333 (KFTI—79-43, pp 101-103) **Coherent two-flow instabilities in a compensated electron ring.** Veingardt, V.F.; Grigor'ev, V.P. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1979. (In Russian). Dep. NTIS (US Sales Only).

From 6. all-union seminar on linear accelerators; Kharkov, Ukrainian SSR (5 Jun 1979).

By using the kinetic equation method in the linear approximation, the stability of a two-component ring relative to disturbancies related with the space charge field is considered. The dispersion equation which takes into account transversal and longitudinal disturbances has been found for a ring with finite dimensions of the cross-section. A frequency spectrum of instable disturbance harmonics has been determined associated both with oscillations of the beam center of gravity and with oscillations in dimensions of its cross-section. The most fast-rising types of disturbances have been discriminated and their increments have been calculated.

2334 (KFTI—79-43, pp 14) **Study on the thermocontrol system on the bench of the second part of the meson factory accelerator.** Batskikh, G.I.; Bidnyi, S.V.; Mirochnik, E.A. (AN SSSR, Moscow. Radiotekhnicheskij Inst.). 1979. (In Russian). Dep. NTIS (US Sales Only).

In Physical experimental techniques.

2335 (KFTI—79-57, pp 77-79) **Problems of automated control system software for multisection electron linear accelerator and some estimations of its efficiency.** Antsupova, V.M.; Bakai, A.S.; Boriskin, V.N.; Grishaev, I.A.; Dem'yanenko, G.K.; Kobezski, V.M.; Lyubarskii, G.Ya. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Physical experiment technique.

Software of automation control system of multisection electron linear accelerator is described. The software composition is oriented to carry out the following tasks: accelerator operation control, diagnostics and failure forecasting for accelerator systems, conducting experiments on accelerator physics and accelerator technology. The system efficiency is estimated on the basis of data recieved during several years of experimental and industrial operation. It is shown that the main effect during the system introduction into the on-line accelerating complex is achieved at the expense of providing with additional information the accelerator authorities and those responsible for the system operation.

2336 **Recent work on bakeable flange pairs of dissimilar metals.** Unterlerchner, W.; Delfosse, J.; Jenson, D. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 86-89 of Proceedings of the eighth international vacuum congress. Vol. 2. Vacuum technology and vacuum metallurgy. Langeron, J.P.; Maurice, L. (eds.). Paris, France; Societe Francaise du Vide (1980).

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

Junctions of stainless steel vacuum components to non-ferrous metallic components are traditionally made by diffusion bonded transitions. This work describes the principle, design and performance of all metal vacuum joints comprising a bakeable aluminium to stainless steel flange pair, which have been developed for the LEP project at CERN. The large electron positron storage ring, LEP, has a circumference of more than 30 km with a tubular vacuum system constructed from aluminium extrusions. Most of the vacuum hardware attached to it, like pumps, feedthroughs or extension bellows, are mounted on stainless steel flanges. The size of the vacuum systems, the large number of vacuum components and the design pressure of 3.10^{-9} torr with circulating beams call for a reliable and economic design of the junctions. The newly developed quick coupling fulfills these demands and simplifies the design and the maintenance of the LEP vacuum system.

2337 **Vacuum system of GANIL.** Rommel, G. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). pp 105-109 of Proceedings of the eighth international vacuum congress. Vol. 2. Vacuum technology and vacuum metallurgy. Langeron, J.P.; Maurice, L. (eds.). Paris, France; Societe Francaise du Vide (1980).

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

GANIL is a particle accelerator at this time in construction in Caen. This machine must accelerate all ions from Carbon to Uranium to obtain energies from 100 MeV/nucleon (Carbon) and 5 MeV/nucleon (Uranium). GANIL mainly consist in 3 accelerators at first a classical cyclotron being followed by 2 separated sector cyclotrons. A beam line equipped with many apparatus assures the carriage of particles from the first cyclotron to physicist experiments. The pressure inside every machine and inside every different part of beam line must be low enough to conserve particles. That pressure depends on nature, speed, and charge of ions. The value of pressure varies from 4.10^{-5} Pa (approximately 4.10^{-7} torr) to 2.10^{-6} Pa (approximately 2.10^{-8} torr). We will only speak here about first separated sector cyclotron which must have a pressure of about 2.10^{-6} Pa.

2338 **First operational experience with the 2.3 km long uhv system of the electron storage ring PETRA.** Falland, C.; Hartwig, H.; Kouptsidis, J.; Kueppershaus, R.; Schumann, G.; Schwartz, M.; Wedekind, H.P. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). pp 126-129 of Proceedings of the eighth international vacuum congress. Vol. 2. Vacuum technology and vacuum metallurgy. Langeron, J.P.; Maurice, L. (eds.). Paris, France; Societe Francaise du Vide (1980).

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

The uhv system of PETRA is divided by gate valves into 30 separate sections of about 100 m length, each provided with a turbomolecular pump and a mass spectrometer. The vacuum chambers in the arcs are made from aluminium extrusions, and the straight sections from stainless steel. The installed mean pumping speed is about 110 l/s/m. The discharge current of the sputter-ion pumps is used to monitor the pressure of the system. All active vacuum components such as pumps, spectrometers, valves, turbomolecular pumps etc., are computer controlled over distances of the order of 1 km. A base pressure lower than 1×10^{-9} mbar is obtained without bake-out. Also an Argon glow discharge cleaning in situ is not needed because of the self cleaning effect of the synchrotron light emitted by the circulating electrons. Pressure increases of about of 1×10^{-10} mbar per stored mA and beam life times of the order of 20 hours have been achieved up to energies of 10 GeV.

2339 **20,000 l s^{-1} cryogenic pump.** Pignet, P.; Robin, P.; Rommel, G. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). pp 312-314 of Proceedings of the eighth international vacuum congress. Vol.2. Vacuum technology and vacuum metallurgy. Langeron, J.P.; Maurice, L. (eds.). Paris, France; Societe Francaise du Vide (1980). (In French)

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

This pump is the first of a series of sixteen pumps that are to be fitted to the two separate-sector cyclotrons of GANIL. The manufacture of these pumps has been entrusted to the PHYSIMECA Company. This system should enable a pressure of around $2x10^{-6}$Pa ($2x10^{-8}$ Torr) to be reached in the vacuum chamber of the separate-sector cyclotron.

2340 **Operation of the variable energy cyclotron at Calcutta.** pp 310-315 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The 224 cm Variable Energy Cyclotron at Calcutta with design energies of 140 Q^2/A has been completed. An external beam of 30 MeV alphas was obtained in July 1978. During the beam trials, experience has been gained on the operation of various systems and the reliability tested. Results obtained on cyclotron operation are presented. Beam transport and data processing systems are being installed and plans for utilization are underway.

2341 **Operational characteristics of VEC vacuum system.** Viswanadham, C.; Bhavsar, S.T.; Bose, D.K.; Chintalapudi, S.N.; Das, S.K.; Tiwary, S.D. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 319-321 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The main vacuum system of the Variable Energy Cyclotron which has been built indigenously has fulfilled the requirements for the smooth operation of the machine. By running two 88.9 cm diffusion pumps with freon cooled baffles and backed by 600 l/m rotary pumps, a pressure of 5×10^{-6} torr in absence of the beam and 1×10^{-5} torr in presence of the beam is readily achieved in the 23 m^3 volume. Various means have been adopted to maintain the system in order and contamination-free, by maintaining a pressure level of 1×10^{-4} torr throughout the working week by a 30 cm diffusion pump, which can run even on emergency power. Cryopanels have also been installed and tried out. Details of pump-down characteristics and system performance are discussed.

2342 **High vacuum test of the dynamic components of the cyclotron Dee Chamber at the 224 cm variable energy cyclotron.** Chintalapudi, S.N.; Bandopadhyay, D.K.; Ghosh, D.K.; Gowariker, S.R. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 322-324 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The 224 cm Variable Energy Cyclotron constructed and commissioned at Calcutta comprises a number of dynamic components in the high vacuum Dee Chamber. The static and dynamic conditions of these components have to be tested for high vacuum worthiness prior to their installation in the Dee Tank. A special set up was fabricated and used for simulating the Dee Chamber conditions and testing the components. A high vacuum of the order of 1×10^{-5} torr was achieved under both dynamic and static conditions with and without coolant hydraulic pressures. The details of the set up, methods employed for the various tests carried out and the results obtained are described.

2343 **VEC power supplies: operating experience.** Ramamurthi, S.S.; De, T.K.; Karandikar, H.N.; Koshy, M.; Mukhopadhyay, N.K.; Sathe, M.M.; Sengupta, R.N. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 325-327 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The technology of fabricating precision dc magnet supplies has been developed and utilized in the Variable Energy Cyclotron. Stability of 0.01% at current levels upto 2500 A has been achieved. The reliability of the units was confirmed during the operation of the machine. Other power supplies such as the 20 kV, 20 A dc, oscillator supply, ion source supply and 120 kV Cockroft-Walton Deflector supply were also developed and their performance tested. Experience gained during operation of these units both under stable and erratic mains voltage conditions is discussed.

2344 **Operational characteristics of the VEC radio-frequency system.** Khemka, P.K.; Basu Mallik, D.N.; Bhattacharya, D.S.; Mukherjee, A.K.; Mukherjee, B.; Ramamurthy, S.S. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 328-331 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The operating characteristics of the 400 kW rf system of the VEC, based on the RCA 6949 oscillator tube, and covering a frequency range of 5.5 to 16.5 MHz, are described. The frequency stability of the system is measured to be 1 part in 10^5, and a dee voltage of 40 kV at 8 MHz has been achieved. The results of experimental adjustments of ratio capacitor for proper excitation and appropriate fixed dee voltage over the entire frequency range are discussed. An analysis of the multi-pactoring encountered during beam trials is presented.

2345 **Operational characteristics of the VEC extraction system.** Sethi, R.C.; Bandopadhyay, D.K.; Bhavsar, S.T.; De, T.K.; Ghosh, D.K.; Gowariker, S.R.; Gupta, S.C.; Mukhopadhyay, B.; Pathak, L.M. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 341-343 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

Extraction system (Deflector) of VEC, which is of electrostatic type has been installed and is in operation. Calibration procedure of the deflector for setting it in any desired position is discussed. Reproducibility of better than 100 microns in the movements of the electrodes has been achieved. Remote movements of the electrodes is monitored in the control room with the help of a quarter scale model of the deflector. Baking procedure for melting off the sharp spicules on the surface of the electrodes has been described. Under a pressure of approximately 2 x 10/sup -5t/ and magnetic field of approximately 10 kG, an electric field gradient of 7 kV/mm has been achieved. The optimized parameters, voltage and channel positions, for a given energy and particle have been calculated with the help of computer code DFLKTR. For a Dee voltage of 40 kV, the extraction efficiency for 50 MeV α is estimated to be 48%. The behavior of the deflector during beam trials is discussed.

2346 **915 mm scattering chamber for the variable energy cyclotron, Calcutta.** Chintalapudi, S.N.; Barde, M.L.; Murty, G.S.N. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 344-345 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

Fabrication and assembly of a sophisticated precision 915 mm dia scattering chamber as a part of users facilities at VEC has been completed. The chamber features complete remote operation with multiple target, multiple detector provision and gas targets. Accuracies of the order of 0.05 mm in beam-target-detector alignment and a 1 minute detector angular resolution have been achieved. The chamber can be used for angular distribution (with backward angles upto $\Theta Lab = 165°$) and other measurements employing several particle telescopes simultaneously for nuclear scattering and reactions experiments. The details of the technical and operational features of the chamber are described.

2347 **Software development for on-line computation with PDP 15/76 computer.** Viyogi, Y.P.; Bhattacharjee, T.K.; De, S.K.; Basu, A.K.; Ganguly, N.K. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 346-348 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

Two important capabilities have been incorporated in the on-line data processing system for the pulse height analysis at VEC, for the processing of data by using codes PHA1 and PHA2, the single parameter and dual parameter data acquisition programs. (1) RDMA is written in assembly language for randomly accessing any element of data from data filing devices. This increases the availability of core so that capability of processing programs can be enhanced. (2) PHARAD, also written in assembly language, converts data files created by acquisition programs into FORTRAN compatible files. These are very essential for on-line processing of data. The on-line data acqujsition and processing by PDP 15/76 using these facilities are discussed.

2348 **Ion source operation and beam diagnostics at VEC, Calcutta.** Bhandari, R.K.; Bandyopadhyay, O.K.; Bhavsar, S.T. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project). pp 338-340 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The ion-source for the VEC is a hot cathode PIG type source with water cooled copper anode in the form of a chimney. The source was operated with the helium gas during the beam trials. Sufficiently stable arc current over 1A was obtained. The arc characteristics are described here. Effect of variation of the filament current, arc voltage and gas flow on the arc current are discussed. There are 3 diagnostic probes on the VEC. Water cooled single finger and 3 finger probes were extensively used to tune the beam at various radii. The probes can be placed at any radius from 2.5 cm to more than 125 cm and their positions monitored from the control room. One of the probes was used to mount the target for the internal irradiation. Role of these probes in tuning the beam is described.

2349 **Ion accelerator for fast neutron generation.** Joglekar, A.G.; Lahoti, P.S.; Chindhade, V.K.; Bhiday, M.R.; Bhoraskar, V.N. (Poona Univ. (India). Dept. of Physics). pp 282-284 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

Design, fabrication and use of an ion-accelerating system to be used for generation of fast neutrons are described. The main features of the system are a 200 KV D.C. power supply, R.F. discharge type ion-source, an accelerating column and a remote control system to function at 200 KV. The improved extraction geometry inside the R.F. ion-source has resulted in an increased out-put of deuterium and hydrogen ions, and stabilized the gas discharge to keep extracted current steady. The electrodes inside the accelerating column are shaped to provide strong focussing along with effective acceleration of the ions. The beam after passing through the accelerating column can have minimum diameter of about 8 mm. The remote control system is based on mechanical operation controlled by electronic circuits. About 200 μA deuterium ion-current has been successfully detected at 200 keV. These ions are proposed to be used for the generation of fast neutrons using tritium and deuterium targets.

2350 **Ion accelerator 150 keV for the manufacture of radiation sources used in nuclear spectroscopy.** Subotovich, M.; Paprotski, K.; Yalokhovski, M.; Mikolaichak, P. pp 147-153 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

Described is an ion accelerator (150 keV) for manufacturing radioactive sources used to measure $\gamma\gamma$ and $\beta\beta$ disturbed angular correlations. The accelerator comprises an ion source with arc discharge, a three-electrode extraction and focusing system, magnetic mass analyzer with double focusing, beam transport system, scanning system and target chamber. The beam was passed via a controlled (0-40 mm) slit to obtain a specific isotope. The ion beam current was 10^{-11}-10^{-8} A. The accelerator separated nuclides with atomic masses from 5 to 210, and it was used for measuring mass spectra of nuclides of various elements (mass from 12 to 208). The relative abundance of stable nuclides of lead, cadmium and copper was determined in a natural mixture of isotopes of the elements; the above relative abundance was found to be in a good agreement with available results.

2351 **Possibility of improving beam monochromaticity of charged particles extracted from an accelerator.** Siksin, V.S. pp 247-255 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

A system for monochromatizing the energy of charged particle beam extracted from an accelerator to improve the resolution of a magnetic analyzer is considered. It is proposed to install a system of quadrupole lenses beyond the magnetic analyzer focus, which would produce a diverging beam at an output slit located in the dispersion plane after the system. In this case, the width of the output slit must be much smaller than that of the beam section in the slit plane. The focal distances and positions of the principal planes were calculated in the approximation of thick lenses for an antisymmetric lens doublet. The beam focusing with the formation of a virtual image at a distance of not over 130 cm is shown to be necessary to obtain high energy resolution of the monochromator. The problems of correcting the position of the beam crossover image and retaining constant energy resolution are discussed. Replacement of doublets of magnetic quadrupole lenses by a doublet of combined lenses in the monochromator and introduction of a system of automatic correction of the position of the beam crossover image are shown to make it possible to maintain the constant monochromator energy resolution at monotonous energy variations of accelerators.

4304 Storage Rings

2352 (JINR-D—9-12965, pp 56-82) **CERN antiproton programme.** Herr, H. (European Organization for Nuclear Research, Geneva (Switzerland)). 1979. Dep. NTIS (US Sales Only).

From International school for young scientists on charged particle accelerators; Minsk, Byelorussian SSR (17 - 25 Aug 1979).

A diagram and basic parameters of the ICE (Initial Cooling Experiment) storage ring constructed in CERN are examined. The experimental results of stochastic and electron cooling and the results of measuring of the antiproton lifetime are discussed. The main parameters of the antiproton storage are listed. Comparison between stochastic and electron cooling has shown that the latter is characterized by shorter cooling time independent of the particle number in a beam. Advantage of stochastic cooling lies in its possible usage at higher energies.

2353 **Ultra high vacuum system for BESSY: the Berlin electron storage ring for synchrotron radiation.** Pingel, H.; Schulz, L. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). pp 119-122 of Proceedings of the eighth international vacuum congress. Vol. 2. Vacuum technology and vacuum metallurgy. Langeron, J.P.; Maurice, L. (eds.). Paris, France; Societe Francaise du Vide (1980).

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

The BESSY high current electron storage ring, build in Berlin, is one of the typical high power uv-light sources. As much duty time as possible will be wanted, when the machine will be operating. A bakeable, stainless 10^{-8} steel vacuum system is therefore provided to give adequate beam life time with $.10^{-9}$ mbar average presure in presence of a 500 mA electron beam after fast start up of the system. Prepumping will be done by turbo-molecular-pumps with oil-free operation. The operating pumping system consists of 400 $1.sec^{-1}$ lumped sputter ion pumps and of special designed hole plate integrated sputter ion pumps for high field application.

2354 **Vacuum system for the accumulation of antiprotons.** Blechschmidt, D.; Brunet, J.C.; Godot, J.C.; Jones, E.; Poncet, A.; Schuhbaeck, H.; Strubin, P.; Wikberg, T. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 123-125 of Proceedings of the eighth international vacuum congress. Vol. 2. Vacuum technology and vacuum metallurgy. Langeron, J.P.; Maurice, L. (eds.). Paris, France; Societe Francaise du Vide (1980).

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

A new facility will provide dense antiproton beams for high-energy physics at CERN; it is scheduled to start operation in summer 1980. Antiprotons are produced, accumulated and stochastically cooled within cycles of about 1 to 2 days, imposing an average pressure $< 10^{-10}$ torr to keep the beam-gas scattering below the acceptable limit. The vacuum system in which the beam is stored is hexagonal with 157 m circumference. It is built from stainless steel and designed for bakeout temperatures up to 350°C. More than 16 banks of 720 mm and 1100 mm diameter accommodate the numerous ferrite pick-ups, kickers, fast cycling shutters, and beam diagnostics, in addition to the beam which is up to 650 mm wide and 150 mm high. The pumping system is designed with microprocessor-controlled, air-cooled turbomolcular pump stations, new constant rate Ti-sublimation pumps, and conventional sputter-ion pumps with supplies particularly designed for high power output. Apart from standard Pirani/Penning gauges, autoranging BA-gauge supply units are used. Further, several hundred feedthroughs, particularly built for high frequency, are installed. First results of the complete machine vacuum performance will be presented.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 2053, 2173, 2201, 2332, 2470, 2632, 2948

2355 (ESA-SP—152, pp 425-429) **HXR80M-balloon experiment: a microprocessor-controlled transatlantic payload.** Ubertini, P.; Bazzano, A.; Boccaccini, L. (Consiglio Nazionale delle Ricerche, Frascati (Italy). Lab. di Astrofisica Spaziale) (and others). Jun 1980. NTIS (US Sales Only).

From 5. ESA-PAC symposium on European rocket and balloon programmes and related research; Bournemouth, UK (14 Apr 1980).

Following the results obtained from the succesful transatlantic flight launched during the summer 1976 from the CNR Milo Base, Sicily, the Laboratorio di Astrofisica Spaziale has started a new program in the hard X-ray astronomy field. It basically consists in the development of high resolution large area Multiwire Proportional Chambers to be employed in long duration balloon flights to study and monitor galactic and extragalactic sources. This note will describe the flight configuration and performances of the HXR80M payload. The experiment is expected to fly during July 1980 from the Milo Base in the framework of the CNR experimental balloon campaign. The note will analyze the main characteristics of the detectors employed, of the data handling electronics and in particular of the hardware and the software of the on-board microprocessor controlled multichannel analyzer. In fact the limitation due to the low bit rate HF link (1.2kbit/s) and the long flight duration (about one week) make imperative the use of an on-board microprocessor system to handle and select in real time the scientific data and to control the housekeeping and the telecommand systems.

2356 (EUR—6813(Vol.1), pp 653-667) **Progress report on the IAEA programme on the standardization of neutron measurements.** Ertek, C.; Gross, B.; Chernyshev, V. (International Atomic Energy Agency, Vienna (Austria)). 1980. Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

A programme on standardization of reactor radiation measurements has been set up by the International Atomic Energy Agency. Among techniques used at present for neutron spectrometry, the foil activation technique has several advantages. Especially for on-pile measurements, and this technique is now commonly used in many different kind of reactors, accelerators, medical centers, etc. The development of the multiple foil neutron activation technique in the last years has allowed one to obtain detailed spectrum information for the whole energy range of importance for reactor technology. Only a rough estimation of the thermal and fast neutron flux can be obtained when using less sophisticated techniques. The completed intercomparisons, theoretical and experimental saturation activity determinations, different neutron flux spectrum unfolding code implementations, tests and evaluation of results for Member States Laboratories, are discussed and relevant references are given.

2357 (EUR—6813(Vol.1), pp 623-630) **Remarks on accuracies in neutron metrology.** Schneider, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). 1980. Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

The analysis of uncertainties to be taken into account for the determination of neutron measuring quantities has attained great importance. This is due to the fact that safety related irradiation studies of nuclear reactor materials nowadays are performed on larger scale and have become a much more subtle problem than before. The aim of this paper is to find some guide lines as a basis for a more detailed analysis. Reported are uncertainty guess values for neutron spectrum (depending on the used measuring reactions) and fluence determination (neglecting damage effects).

2358 (EUR—6813(Vol.2), pp 937-945) **Neutron spectrometry in France.** Clement, C.; Capgras, A.; Sueur, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Lab. de Metrologie des Rayonnements Ionisants). 1980. (In French). Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Various different spectrometry methods have been developed in France. Their choice depends on the energy field, the desired degree of accuracy, the maximum size of the detector, the complexity of setting up the operation, the presence of radiation and the temperature at the point of measurement. The principal methods have been divided into six groups according to the types of detectors: a) - activation detectors; b) - fission chambers, Bonner spheres, self powered detectors; c) - recoil protons detectors; d) - ionographic detectors; e) - Li^6 detectors; f) - time of flight detectors.

2359 (EUR—6813(Vol.2), pp 1129-1144) **Solid track detectors and their utilization in neutron dosimetry.** Debeauvais, M.; Tripier, J. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Amoudry, F. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1980. (In French). Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

The oldest detectors of individual tracks is the ionographic emulsion. Over more than ten years ago a new class of track detectors appeared. These materials are insulators such as cellulose byproducts, polycarbonates, micas, glasses, etc., which we shall call SSTR (Solid State Track Recorder). After presenting the visual detectors now available, their characteristics and their possible uses in dosimetry and spectrometry, an example is given of the application of a SSTR to the determination of spectrum indices.

2360 (EUR—6813(Vol.2), pp 1237-1244) **New developments in calorimetry at the Grenoble Nuclear Centre.** Petitcolas, H. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1980. (In French). Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Since intense gamma radiation in a nuclear reactor is determined mainly by calorimetry in a graphite sample, an endeavour was made to find out how to pass from the specific power deposited by gamma radiations in a graphite core calorimeter to the specific power deposited in materials varying in nature and geometry. To do so, some ten different calorimeters were irradiated in various parts of the MELUSINE (8MW) and SILOE (35MW) test reactors. Concurrently a calculation code was used to interpret the results.

2361 (INIS-mf—6528, pp 114-117) **Application of solid-state track detectors for leakage tests of neutron sources.** Kocsis, Z.; Hazi, E. (Veszpremi Vegyipari Egyetem (Hungary). Radiokemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A solid-state track detector, type Macrofol E has been used for the contamination tests of ^{226}Ra/Be and ^{210}Po/Be neutron sources. The etching conditions used for the development of the tracks of alpha particles were selected so that the influence of neutron-radiation could be neglected.

2362 (INIS-mf—6528, pp 50-53) **Application of neutron-interaction based radiometric measurements in continuous industrial technologies.** Faludi, G.; Hazi, E. (Veszpremi Vegyipari Egyetem (Hungary). Radiokemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A number of measuring methods (such as moisture determination, hydrogen content determination, etc.) have been developed based on the interactions of neutrons and various materials (slowing-down, absorption, scattering). This paper deals with the disturbances (mainly with the effects of space-filling changes) of neutron interaction based radiometrical measurement methods used in the continuous industrial technologies and the elimination methods of these disturbances. The socalled dual-channel elimination method is discussed in detail.

2363 (INIS-mf—6528, pp 106-109) **Application of gamma-reflection for a level-controlling transducer.** Jelinko, B.; Hazi, E. (Veszpremi Vegyipari Egyetem (Hungary). Radiokemiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

A method to monitor the level of aqueous solutions and slurries was developed. It is based on the reflection of gamma radiation and allows for the continuous contact-free monitoring in open or closed tanks by measuring the radiation intensity of the ^{241}Am gamma-source reflected from the liquid surface.

2364 (INIS-mf—6542, pp vp) **Fading of different thermoluminescent dosimeters.** Ben-Shachar, B.; German, U.; Weiser, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2365 (INIS-mf—6542, pp vp) **Effect of interdiffusion on the performance of $PbTe-Pb_{0.8}Sn_{0.2}Te$ IR detectors.** Eger, D.; Oron, M.; Rotter, S.; Tamari, N.; Zussman, A.; Zemel, A; El-Hanani, U. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2366 (INT—129/I, pp 75-85) **Investigation of the periodic changes in bulk density, humidity and underground flows in post-flotation sediments.** Szteler, J. (Polska Akademia Nauk, Gdansk. Inst. Budownictwa Wodnego). 1978. (In Polish). Dep. NTIS (US Sales Only).

From 2. Scientific seminar on transport and sedimentation of solid particles; Trzebieszowice, Poland (1976).

The bulk density and humidity was measured using the gamma-gamma and neutron probe respectively. The radioisotope method was adopted for investigation of underground flows. The investigation was carried out in order to find possible application of isotope methods to industrial sludges.

2367 (JINR-R—18-12147, pp 331-334) **Projection drift chamber for neutron radiography.** Mouchka, L.; Peshekhonov, V.D.; Sitar, B.; Sitarova, L. 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

A version of a detector for neutron radiography -a neutron drift projection chamber (NDPC) is proposed. The chamber should provide a required resolution at good discrimination of the gamma background. Thermal neutrons bombard a converter of ^{10}B in which the $^{10}B(n, \alpha)^{7}Li$ reaction takes place. The alpha particles E=1.5 MeV enter the drift gap filled with vapours of methylal, ethylene or the like, traverse it and are detected by a scintillation counter. In the drift gap a longitudinal electric field is produced and the alpha particle coordinates are determined from the time of electron drift from a track to the anode of a corresponding scintillation counter. The KDPC can operate on line with a computer. The value of the instrument spatial resolution is expected to be 0.3 mm at an efficiency of about 1 per cent, which compares favourably with the resolution of TV systems used in neutron radiography. A low gamma-radiation sensitivity permits the employment of this detector for radiography of reactor irradiated fuel elements.

2368 (KFTI—80-6, pp 82-83) **Polarimeter for measuring of gamma-quantum linear polarization in 20-500 MeV energy range.** Adishchev, Yu.N.; Anan'in, P.S.; Vdovin, V.P.; Zabaev, V.N.; Kuznetsov, V.M.; Potylitsyn, A.P.; Tomchakov, V.K. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

A scheme of the polarimeter based on recording the plane and spread angle of e^+e^- pairs is suggested for measuring polarization of γ-quanta beam over the energy range of 20-500 MeV. The polarimeter consists of a NaI detector for detecting the total pair energy, a spark chamber for measuring electron-positron coordinates, and logic circuits discriminating the preset energy range of measurements. The analyzing power reaches for the spread angle of 0.35 Mrad at photon energy of 500 MeV.

2369 (KFTI—80-6, pp 71) **Processing of film information from streamer chamber.** Anan'in, P.S.; Glavanakov, I.V.; Gushtan, M.N.; Stibunov, V.N. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

Briefly described are the programs for processing film data from a streamer chamber used for studying photoproduction of neutral mesons on helium nuclei. There are the following basic stages in data processing: geometric and kinematic reconstruction of events, evaluation of detection efficiency, grouping with respect to kinematic variables, computation of the differential cross section of the process under study.

2370 (KFTI—80-6, pp 69-70) **Magnetic spectrometer with the SK-600 streamer chamber at the 2 GeV electron linear accelerator.** Tonapetyan, S.G.; Nikitin, V.A.; Khvorostyan, V.M.; Vinokurov, E.A.; Ermak, V.P.; Lyakhno, Yu.P.; Gorbenko, E.S.; Kokhnyuk, K.S.; Dorofeev, M.T.; Kovalenko, O.P. 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

A magnetic spectrometer with the SC-600 streamer chamber is described. The spectrometer is intended for studying multiple photo- and electroproduction of particles on nucleons and light nuclei at the 2 GeV electron linear accelerator. The spectrometer consists of the SP-81 magnet, the SC-600 streamer chamber of 600x600x(2x120) mm in size, a high-voltage pulse generator, the Bluhmlein shaping line, a set of plastic scintillation counters which serve for triggering the streamer chamber, a stereoscopic camera and a system of gas supply. Nowadays the manufacture of all the systems of the spectrometer is completed for the most part, and they are under study.

2371 (KFTI—80-6, pp 64-68) **Study on operation of self-shunting helium streamer chamber with photon beam.** Arkatov, Yu.M.; Vatset, P.I.; Voloshchuk, V.I.; Zolenko, V.A.; Prokhorets, I.M. 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

The results of investigation are presented on operation of a streamer chamber with helium filling when up to $5x10^5$ photons with a maximum energt of 150 MeV are admitted into its working volume. It is shown that in the helium streamer chamber operating in the self-shunting regime a visual identification of charged particles, the products of helium photodisintegration, is possible.

2372 (KFTI—80-6, pp 58-59) **Coordinate-sensitive time-of-flight detectors for study of reactions with gamma quantum production.** Baranov, P.S.; Gorbov, L.A.; Zhuravlev, E.E.; Nafikov, A.A.; Osadchii, A.I.; Smirnov, P.A.; Raevskii, V.G.; Cherepnya, S.N.; Yanulis, Yu.P. (AN SSSR, Moscow. Fizicheskij Inst.). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

Position-sensitive time detectors of two types have been developed: extended detectors and scintillators of large sizes, 50x50 cm in cross section, with four photomultipliers at cut-off angles. In the detectors are employed the ChP 1020, 63, 87, 30 photomultipliers chosen according to the best time characteristics, with individual dividers corresponding to minimum time resolution. Time and coordinate characteristics of detectors were examined in beams of monochromatic electrons of energy up to 300 MeV. The results of investigations are tabulated. For 4x4x4 cm detector, with two ChP 1020 photomultipliers, time resolution of 290 ps and space resolution of 3.6 cm are obtained; for 100x10x10 cm detector with two PhEhU-63 photomultipliers, time resolution of 200 ps and space resolution of 2.7 cm are obtained. The resolution of a starting detector in these measurements is 65 ps.

2373 (KFTI—80-6, pp 57) **Measuring technique for π^+-meson photoproduction asymmetry at big and small angles.** Vdovin, V.P.; Zabaev, V.N.; Kuznetsov, V.M.; Repenko, E.V.; Stukov, O.I.; Tomchakov, V.K. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

A technique is suggested for discriminating the $\gamma p \rightarrow \pi^+ n$ process for π^{+-} meson escape angles close to zero and to 180 deg in order to determine asymmetries of the process mentioned above. π^+ mesons are detected by a ring scintillation counter telescope. Each counter is scanned by two PhEhU-30 photomultipliers pion distribution. Angular is determined with the help of an eight-lobed coordination counter with angular resolution of +-22.5 deg. The energy of π^+ mesons is determined from the range, and their identification is made by the $\pi^+ \rightarrow \mu^+$ decay.

2374 (KFTI—80-6, pp 76-77) **Time characteristics for thin-film threshold breakdown counters of fission fragments.** Smirnov, A.N. (Radievyj Inst., Leningrad (USSR)). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

The basic time characteristics of threshold breakdown counters of fission fragments, made on the base of silicon MOP structures with the sensitive surface area up to 9 cm^2 have been examined. Time resolution measured with the help of a ^{252}Cf source by recording coincidence between fission fragments was not greater than 10^{-9} s. The dead time of the breakdown counters is defined by pulse duration at the output of shaping circuits. Advantages of the counters over other types of threshold detectors of fission fragments are pointed out.

2375 (KFTI—80-6, pp 74-75) **Spark chamber operation in ionization measurement regime.** Anan'in, P.S.; Gushtan, M.N.; Stibunov, V.N. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

In order to clarify the practical possibility of identification and spectrometry of charged particles by discharge formation time, the resolution of a spark spectrometer was measured at various operating gases (Ne and He), gap values and electric fields. Measurements of fluctuations of formation time dependepending on the gas gap, were performed by means of an electron beam. Measurements of dependences of formation time and its fluctuations on the magnitude of ionization losses were carried out by means of the beam of secondary particles (electrons and protons with the velocity β=0.63...0.25), discriminated by a scintillation telescope. 40 % resolution by pulse formation time has been obtained at the spark spectrometer with 3 cm gap.

2376 **Consistent X-ray counting efficiencies for plutonium in lungs, derived by independent methods.** Newton, D. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.); Campbell, G.W.; Anderson, A.L.; Fisher, J.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Health Physics;* **40**: No. 5, 748-753(May 1981).

A recently developed phantom was used to compare the X-ray detection efficiencies for ^{103}Pd and plutonium, present in the phantom's lungs, with efficiencies previously recorded for ^{103}Pd deposited in the lungs of volunteers, or derived for plutonium from those observations. Also values for the ratio R defined as the counts per K X-ray emitted by ^{103}Pd to the counts per L X-ray emitted by plutonium in the lungs were deduced and were compared to the values of R predicted by calculation. The results showed an encouraging similarity between the detection efficiencies for ^{103}Pd in the phantom and those recorded for ^{103}Pd in vivo, suggesting that the pulmonary distribution of activity in the experimental subjects was similar to that in the phantom, i.e. that it was essentially uniform. The further consistency between detection efficiencies for plutonium for the phantom and those derived from data on ^{103}Pd in vivo, together with the overall similarity between predicted and observed values of R has improved the confidence in these two quite different approaches to the problem of calibration.

2377 **Particle identification by electron cluster detection of transition radiation photons.** Ludlam, T.; Platner, E.; Polychronakos, V. (Brookhaven National Lab., Upton, NY (USA)); Deutschmann, M.; Struczinski, W. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.); Fabjan, C.W.; Willis, W. (European Organization for Nuclear Research, Geneva (Switzerland)); Gavrilenko, I.; Maiburov, S.; Shmeleva, A. (AN SSSR, Moscow. Inst. Fiziki). *Nuclear Instruments and Methods;* **180**: No. 2/3, 413-418(1 Apr 1981).

A transition radiation (TR) detector has been built which measures the distribution of charge along the particle track in the gas of a drift chamber. Charge clusters are observed arising from track ionization and the detection of TR photons. A cluster counting method based on these measurements is shown to have a con-

siderable advantage with respect to the normal measurement of the total deposited charge.

2378 **Design, construction, and performance of a high-resolution $\pi 0$ spectrometer for nuclear physics experiments.** Baer, H.W.; Bolton, R.D.; Bowman, J.D.; Cooper, M.D.; Cverna, F.H.; Heffner, R.H.; Hoffman, C.M.; King, N.S.P.; Piffaretti, J. (Los Alamos Scientific Lab., NM (USA)). *Nuclear Instruments and Methods;* **180**: No. 2/3, 445-459(1 Apr 1981).

A spectrometer for the detection of neutral pions in nuclear physics research was designed, constructed, and tested at the Los Alamos Meson Physics Facility. It is capable of detecting neutral pions with high efficiency, and with a fwhm energy resolution of 2 MeV with a typical acceptance of 1 msr. In the first experiment in which the spectrometer was used, its performance was evaluated, and nuclear physics research, based on the detection of neutral pions, was performed.

2379 **Portable fluorometric spotter for detection of surface contamination by polynuclear aromatic compounds.** Schuresko, D.D. (Oak Ridge National Lab., TN). pp 551-560 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981). Contract W-7405-ENG-26.

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper describes the capabilities of the portable fluorescence spotter, which has been developed at ORNL, to qualitatively detect surface contamination by PAH containing materials, and to quantify PAH skin contamination caused by contact with coal-derived liquids. (KRM)

2380 **Remarks on the present TLD concept in personnel monitoring.** Regulla, D.F.; Drexler, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). pp 339-342 of Radiation protection. A systematic approach to safety. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

The reasons for lack of success in establishing TLD instead on film dosimetry for personnel monitoring is discussed in the light of technical considerations, particularly of automation problems, and of the limitations of personnel monitoring services, which frequently have to be run as 'remote control' services, rather than 'on site' assessment of working conditions.

2381 **Phosphate glass dosimetry. A potential alternative in personnel monitoring.** Piesch, E.K.A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)); Regulla, D.F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). pp 343-346 of Radiation protection. A systematic approach to safety. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

The use of phosphate glass dosimetry is reassessed in the light of German experience. The following properties of current glass dosimetry are considered in relation to LiF TLD systems: 1) New glass compositions giving low energy dependence and high batch uniformity and the ability to determine individual predose values reproducibly. The use of perforated filters also improves energy dependence. 2) Improvements in automatic read-out systems. 3) Multidirectional scanning. 4) Laser pulse excitation for suppression of predose. This new readout technique was good for exposure assessment as low as 10 mR or even down to 0.1 mR when using the time constant as a measure of dose.

2382 **Fast neutron dosimetry using $CaSO_4$:Dy thermoluminescent dosimeters.** Azorin, N.J.; Salvi, C.R.; Rubio, J.L.; Gutierrez, C.A. (Instituto Nacional de Investigaciones Nucleares (Mexico)). pp 351-354 of Radiation protection. A systematic approach to safety. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

The following conclusions have been drawn from this investigation: 1) Sulphur activation in $CaSO_4$:Dy thermoluminescent dosimeters is a useful method in fast neutron dosimetry. 2) A calibration curve for fast neutron dose as a function of accumulated thermoluminescence during a post-irradiation time of 30 d, was obtained as a straight line in a full log paper in the dose range 2 to 10^4 Gy. 3) The minimum fast neutron dose measurable with $CaSO_4$:Dy powder is 9×10^{-4} Gy for measurements made after a post-irradiation time of 30 d.

2383 **European interlaboratory test programme for luminescence dosemeter systems used in environmental monitoring.** Burgkhardt, B.; Piesch, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)); Seguin, H. (Commission of the European Communities, Luxembourg). pp 355-358 of Radiation protection. A systematic approach to safety. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

In the European Intercomparison Programme of TLD dosemeter systems for environmental monitoring 1978/79, more than 17 laboratories participated with 45 dosemeter systems. An outline summary of the results is presented and the following aspects are discussed: 1) Batch uniformity of different TLD systems 2) Zero dose readings 3) Reproducibility.

2384 **Simultaneous sensation and re-estimation in thermoluminescent LiF.** Charles, M.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.); Khan, Z.U. (Dundee Univ. (UK). Dept. of Medical Biophysics). pp 359-362 of Radiation protection. A systematic approach to safety. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

This paper outlines and extends the results of previous studies of radiation sensitisation of thermoluminescent LiF, together with re-estimation, and shows that the two processes are not incompatible, since the U.V./thermal annealing procedures and U.V. re-estimation are associated with different trapping centres. It is concluded that radiation sensitisation is a useful technique which can reduce the minimum detectable dose for LiF(TL) by a factor of 3, and retain the possibility of dose re-estimation. Further work however is necessary to reduce the background signal associated with re-estimation. The smallest dose which can be re-estimated with sensitised LiF chips (0.9 mm thick) is about 0.2 Gy at the present time.

2385 **Skin dose assessment in routine personnel beta/gamma dosimetry.** Christensen, P. (Risoe National Lab., Roskilde (Denmark)). pp 363-366 of Radiation protection. A systematic approach to safety. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

Three alternative methods are outlined by which substantial improvements of the capabilities of existing routine monitoring systems for skin dose assessment can be obtained. The introduction of a supplementary skin dosemeter may be an attractive method for systems with badges that have a capability for an additional dosemeter already built-in. The two-side reading method has limited possibilities because of reduced accuracy for mixed radiation and technical difficulties in using it for TLD systems with planchet heating. The use of a boron diffused LiF layer for skin dose assessment seems to be most attractive method since the only modification needed here is replacement of a dosemeter. However the study of this method is so far only in a preliminary stage and further investigations are needed.

2386 **Advances in mass spectrometry. Volume 8A.** Quayle, A. (ed.). London, England; Heyden for the Institute of Petroleum (1980). vp. (CONF-790893—(Vol.8A)).

From 8. international mass spectrometry conference; Oslo, Norway (11 Aug 1979).

Separate abstracts are presented for each of the conference papers included in the data base.

2387 **Measurement for progress in science and technology. Volume 2.** Solt, J.; Kemeny, T. (eds.). Amsterdam, Netherlands; North-Holland (1980). vp. (CONF-790525—).

From 8. IMEKO congress; Moscow, USSR (21 May 1979).

Separate abstracts are presented for each of the conference papers included in the data base.

2388 **Advances in mass spectrometry. Volume 8B.** Quayle, A. (ed.). London, England; Heyden for the Institute of Petroleum (1980). vp. (CONF-790893—(Vol.8B)).

From 8. international mass spectrometry conference; Oslo, Norway (11 Aug 1979).

Separate abstracts are presented for each of the conference papers included in the data base.

2389 **Development of a glass dose-meter reader.** Barthe, J.; Blanc, D.; Lescrainier, J. (Toulouse-3 Univ., 31 (France). Centre de Physique Atomique); Portal, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). pp 41-52 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979). (In French)

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

The main disadvantage of the radiophotoluminescent glasses used in personnel dosimetry is their parasitic fluorescence, or "predose", when there has been no previous irradiation; it varies considerably with the mode of manufacture and the nature and purity of the various components. In order to make the glasses usable for general radiation monitoring and personnel monitoring, we have developed a more sensitive and stable reader adapted to the French cylindrical glasses (MC and PB 33) made by Desmarquest and CEC. The design principles of this reader are: (1) Regulation of the UV flux of the exciting lamp; (2) very strict choice of spectrum and blocking value of the filters used; (3) excitation of short duration; the glass is excited for only a short time, less than a second; (4) temperature correction or stabilization; the evolution of the response of the glass varies considerably with temperature, and a thermistor correction system appreciably reduces the dependence of the response on temperature.

2390 **New device for detecting ionizing radiation.** Perino, D.; Lewiner, J.; Dreyfus, G. (Ecole Superieure de Physique et Chimie Industrielles, 75 - Paris (France)). pp 55-61 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979). (In French)

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

A new principle for the detection of ionizing radiation is described. It is based on the decrease in the force exerted on a movable element by an electret when the latter is irradiated. Devices based on this principle can be designed and built to measure the doses received and to trigger an alarm if a predetermined dose is exceeded. These devices, being very simple and handy, and consuming no energy in the vigilant state, should find wide application in radiation protection.

2391 **New type of personal dosemeter.** Ennow, K.R. (State Institute of Radiation Hygiene, Broenshoej, Denmark). pp 63-74 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

Individual monitoring of workers who are exposed to ionizing radiation is normally carried out with a personal dosemeter worn on the worker's trunk. In some situations or working conditions, there seems to be a need for a new type of dosemeter more closely related to the person who is supposed to wear it and which will follow the person between different work-places. We have been looking for a dosemeter system which could fulfil this need and have determined that many workers, for example in maintenance work, industrial radiography, etc., wear their own wrist-watch at work. The wrist-watch calendar used for advertizing and therefore well known has been selected as a carrier of a thermoluminescent dosemeter by pressing a protrusion in the thin aluminium sheet. By using a calendar of commonly used type attached to the watch, the worker will automatically wear the dose meter because of his need for his own wrist-watch. About 90 calendar-type dose meters have been tested under practical conditions during 1977.

2392 **Beta dosimetry with surface-barrier detectors.** Heinzelmann, M.; Schueren, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Strahlenschutz). pp 77-85 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

It is shown that a surface-barrier detector is suited for the determination of beta dose rates. The detector response is energy-independent within +-25% for beta radiation involving peak energies in the range from 230 keV to 2.2 MeV. The detector response depends on the dose rate, but measurements up to 320 rad/h are possible within the limits specified. The energy dependence of the detector response for γ-radiation is also given. Comparative measurements of the beta dose rate in the vicinity of small radioactive sources were carried out using different types of detectors.

2393 **Development of sensitized ultra-thin dose meters for skin-dose assessment.** Charles, M.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.); Khan, Z.U. (Dundee Univ. (UK). Dept. of Medical Biophysics). pp 87-100 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

In recent years new and extensive data have been produced concerning the radiobiology and morphology of the skin. This has led the International Commission on Radiological Protection (ICRP) to recommend that the most appropriate measurement of skin dose is an integrated value between tissue depths of 5 and 10 $mg.cm^{-2}$. This requirement to measure the dose in such a small tissue volume presents severe practical problems since it infers the use of a thin dose meter (with inherently low sensitivity and high minimum detectable dose). An ultra-thin bonded (UTB) dose meter is described which can fulfil this requirement. It is comprised of a microtomed ultra-thin $CaSO_4$ or LiF/Teflon disc (25 μm thick) which is thermally bonded to a thick (approximately 0.2 mm) Teflon base. In order to achieve the maximum sensitivity and lowest possible minimum detectable dose with ^{7}LiF, the process of sensitization, combined with UV/thermal anneal, has been utilized. A study of the basic thermoluminescence mechanisms involved in this process has led to the surprising prediction that simultaneous sensitization and UV re-estimation of dose are possible. This has been confirmed for ^{7}LiF in both 'chip' and Teflon based dose meters. These results should encourage the use of sensitization and will necessitate the modification of some models of thermoluminescence in LiF. The priority for utilization of UTB dose meters is discussed with the aid of typical depth doses for a CEGB nuclear power plant.

2394 **Dosimetry of mixed beta and gamma radiation in work areas.** Hajnal, F.; McLaughlin, J.E. (Department of Energy, New York (USA). Environmental Measurements Lab.). pp 103-114 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

The mixed beta and gamma radiation fields from distributed sources of high-energy beta emitters, such as ^{106}Ru-^{106}Rh and ^{144}Ce-^{144}Pr, encountered during maintenance of nuclear fuel reprocessing plants, require accurate control of any personnel occupancy times. The dose rates may be high and the beta-to-gamma dose rate ratio can vary widely. Our goal was to develop a reliable, portable survey instrument that can provide simultaneous information about the beta and gamma-ray dose rates in the 10^{-3} to 10^{3} rad/h range in mixed fields. A thin walled, double, concentric ionization chamber survey instrument was built and tested in the field. This instrument is equipped with a temperature-compensated, solid-state electrometer and can measure the beta and gamma-ray dose rates simultaneously. A plastic scintillation detector survey instrument is now under development, because more information can be obtained on the mixed beta and gamma radiation field, e.g. the average and maximum energies of the principal beta emitter. This system depends on an electronic version of the absorption method originally developed for sample purity analysis in the laboratory. The results of evaluations and tests with both systems are discussed.

2395 Device for determining the dose-equivalent index of mixed radiations. Zielcynski, M.; Marjanska, S. (Institute of Nuclear Research, Warsaw (Poland)). pp 117-127 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979). (In Russian)

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

A device has been constructed that allows the determination of the absorbed-dose index and the dose-equivalent index of mixed radiations of any composition and spectrum. The principal detector used in the device for measuring the dose equivalent was a small recombination chamber, which was moved along the axis of a spherical phantom filled with a tissue-equivalent liquid. The presence of columnar recombination of ions in the gas of the chamber made the sensitivity of the chamber appropriately dependent upon LET. The device allows the absorbed-dose-rate index over the range of 0.03-10.000 μGy/s (approximately 0.01-3.600 rad/h) with an accuracy of 12% and the dose-equivalent-rate index over the range of 0.03-700 μSv/s (0.01-200 rem/h) with an accuracy of 20% to be determined. Measurements of dose-equivalent index were performed in radiation fields near reactors, neutron generators and high-energy accelerators. Almost in all the cases investigated, the maximum value of dose equivalent within the spherical tissue-equivalent phantom was found to be at a depth not exceeding 2 cm. The measurements performed proved the possibility of determining the dose-equivalent index experimentally in various radiation fields. Some technical difficulties and limitations are presented. The possibility of using a simple method for dose-equivalent index determination using a large recombination chamber is considered.

2396 Dose-rate meter/dose meter unit for emergency operations (E.D.D.I.). Bouet, J.; Dieval, M.; Prigent, R.; Sajaroff, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). pp 129-141 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979). (In French)

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

The emergency dose-rate meter/dose meter unit described is designed for monitoring the working conditions and for personal monitoring of an emergency team operating in a hostile environment. A portable ionization-chamber radiation indicator either worn by personnel or placed in the working area provides information on the radiation field in the environment in which the emergency team is operating. The information provided by the indicator is processed by an appropriate processing unit which determines the absorbed-dose rate and the absorbed dose simultaneously. These two values are displayed on a television screen, superimposed on the picture transmitted by the camera filming the operation. The time and an identification number of the person performing the operation are shown on the same screen; the values of these quantities can be recorded on video tape. The indicator can be linked to the processing system either by a cable up to 100 m long or by radio (the latter system is in the design stage).

2397 Czechoslovak nuclear accident dosimetry system. Methods and organization. Spurny, F.; Turek, K. (Ceskoslovenska Akademie Ved, Prague. Ustav Radiologicke Dozimetrie); Prouza, Z. (Karlova Univ., Prague (Czechoslovakia). Biofyzikalni Ustav). pp 143-152 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

The Czechoslovak nuclear accident dosimetry system has recently been newly elaborated. The paper presents its basic characteristics, from the point of view of the dosimetric methods used as well as of the organization of the data evaluation. It has been recommended that the system incorporates both the personnel dose meters and also the installed, fixed-position monitors. Thermoluminescent glass, photographic film, activation and solid-state track detectors, and silicon diodes are used as sensitive elements. The evaluation comprises three consecutive steps, going from a rather rough evaluation of the maximum surface absorbed dose to obtaining data that are as complete as possible on the depth dose distributions due to both neutrons and gamma rays.

2398 Comparison of neutron personnel monitors: preliminary results of a European intercomparison programme. Schraube, H.; Burger, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz); Seguin, H. (Commission of the European Communities, Luxembourg). pp 165-181 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

The increasing use of nuclear power plants has led to renewed efforts in the development and application of neutral personnel dose meters. In this context an irradiation programme was arranged in order to test dose-meter systems from 15 European laboratories under the same irradiation conditions. Irradiation was performed with fast neutrons in a low backscatter environment, the dose meters being arranged both on a tissue-equivalent phantom and free in air where appropriate. As radiation sources, target reactions at a 3 MeV accelerator were used, producing approximately monoenergetic neutrons in the range 0.5-15 MeV, as well as an americium-beryllium neutron source and a californium spontaneous fission neutron source. The dose-meter systems submitted by the participating institutes were as follows: conventional nuclear track films, dose meters based on the albedo principle but of various technical designs, non-photographic nuclear track detectors with and without an external fission converter, and thermoluminescence detectors. The irradiation conditions, the equipment for monitoring of the radiation, and the physical properties of the dose-meter systems are described. Some preliminary results, obtained with various dose meters, are reported and intercompared.

2399 Use of high-sensitivity fission chambers for neutron spectrometry and dosimetry. Mourgues, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). pp 183-194 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979). (In French)

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

Neutron spectrometry for radiation protection purposes generally involves multi-detector systems, e.g. the multi-sphere technique. Although integral measurements are sufficiently accurate for low doses, the resolving power of such a system is unsatisfactory, in particular for intermediate energies. Particularly sensitive fission chambers may solve this problem. An integrator-type of spectrometric device has been designed, using an assembly of five chambers in which the fissionable elements are uranium-235, neptunium-237 and uranium-238 and comprising screens which form artificial

thresholds. The device is very suitable for making measurements in nuclear facilities such as power plants. The lowest measuring threshold is about 30 mrem/h. If determination of the dose is all that is required, the various fissionable materials can be put into the same chamber, thus forming a simplified rem-counter. Using neptunium-237 and plutonium-238, for example, it is possible to measure doses with an accuracy of 10%, the threshold being 30 mrem/h. Such a device is not only very handy, it also has excellent anisotropic properties.

2400 **Neutron dosimetry system for use in processing plants.** Gibson, J.A.B. (UKAEA Atomic Energy Research Establishment, Harwell). pp 197-205 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

This paper describes the Harwell Neutron Dosimetry System which has been designed for use in a wide variety of processing plants for nuclear fuel. The system is based upon a neptunium-fission dose meter for recording personnel dose equivalents from neutrons, a personal alarm neutron dose meter (PAND) containing a low-pressure proportional counter and a variety of instruments using thermalizing spheres of polyethylene and a helium-3 counter to provide more direct measurements of the dose-equivalent rate and the neutron spectrum. The complete system has been tested in a plutonium processing plant in a variety of locations which were chosen to provide as wide a variety of neutron spectra as possible. The results of the tests have shown that the neptunium dose meter on the phantom measures the neutron dose equivalent with an uncertainty of +-19% (standard deviation) when compared with a counter of the Anderson-Braun type. This uncertainty can be reduced slightly by using an albedo dose meter to provide limited spectral information. The useful range of the neptunium dose meter is from 30 mrem to 10 rem with a sensitivity of 190 tracks per rem and a background due to spontaneous fission of about 40 mrem/a. A prototype PAND when compared with a neptunium dose meter gave the neutron dose equivalent with an uncertainty of +-19% (standard deviation) at a sensitivity of 10 counts/mrem and a useful range from 5 mrem up to 10 rem. Alarms are sounded at 20, 60 and 100 mrem with a read-out of the dose at the end of a period of work. Further tests will be made when the processing plant at Dounreay, Scotland, is operational.

2401 **Advances in albedo neutron dosimetry.** Piesch, E.; Burgkhardt, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). pp 207-228 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

Recent investigations in albedo dosimetry have shown that most results obtained with monoenergetic neutrons are not transferable to neutron fields. In personnel monitoring today, the application of albedo dose meters is, therefore, restricted to making field calibrations in the environs of each neutron source. The paper discusses experimental results, above all the energy and directional dependence of the albedo response for a multi-component dose meter. As an example, the Karlsruhe albedo dose meter provides, in addition to dose readings, information about variations in the local neutron spectra in the working area. On the basis of field calibrations, the neutron spectrum can be interpreted in terms of effective energy and percentage of thermal neutrons. In addition, the calibration technique applied, the energy dependence of reference instruments for field calibration, and the statistical error of a neutron dose measurement in mixed gamma and neutron fields are discussed.

2402 **Measuring neutron dose and quality factors with tissue-equivalent proportional counters.** Brackenbush, L.W.; Endres, G.W.R.; Faust, L.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). pp 231-239 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

This paper reviews the methods used to obtain absolute neutron dose measurements and quality factor determination from the tissue-equivalent proportional counter (TEPC). Exposure to nearly monoenergetic neutrons with energies from 200 keV to 7.5 MeV indicate that the absorbed dose due to fast neutrons measured by the TEPC averaged 3% higher, with a standard deviation (1 sigma) of 9%, than the tissue kerma calculated from neutron fluence measurements. The absorbed dose due to fast neutrons measured by the TEPC agreed within 0.6% of the calculated tissue kerma for a PuBe neutron source, whose neutron yield was determined within 2% by the United States National Bureau of Standards. Data are presented which show that the TEPC measures quality factors accurately enough for health physics purposes for neutrons with energies between 200 keV and 5 MeV.

2403 **Studies on the characteristics of nuclear track spark counting for neutron monitoring.** Kawai, H.; Koga, T.; Morishima, H.; Niwa, T.; Nishiwaki, Y. (Kinki Univ., Higashi-Osaka (Japan)). pp 241-252 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

The fission-track counting method using polycarbonate foil is known to be very effective for neutron monitoring. The detection system consists of a track detector foil placed in contact with a thin layer of fissile material. When the unit is irradiated with neutrons, fission fragments from the fissile material produce tracks in the foil. The foil is then etched chemically to enlarge the tracks to etch-pits, which are counted by an automatic spark counting method suggested by Cross and Tommasino. Spark counting characteristics of the above system using polycarbonate detector foils of different thicknesses and aluminized polyester sheets having different thicknesses of the aluminium which serves as an electrode, and etch-pit sizes in relation to spark counting have been studied. The results obtained are summarized as follows: 1. A growth in etch-pit sizes was observed for etching times of 10 to 50 minutes with Makrofol KG (10 μm thick) and Panlite foils (18 μm thick). As the etching time increased, the number of etch-pits which appeared as round pits increased and the number which appeared rod-like decreased; 2. Round etch-pits seemed to be easily spark-punched; 3. Major and minor diameters of etch-pits produced by fission fragments from the uranium fissile target were larger than those from the thorium target; 4. As the thickness of the Makrofol KG foil increased, the minor diameters of the etch-pits appeared to become smaller and major diameters larger; 5. The foils that appeared to be best suited for routine use were 10 μm thick Makrofol KG or 6 μm thick Lumirror foils.

2404 **Nuclear track detector system for personal neutron monitoring around high-energy accelerators.** Dutrannois, J.; Hoefert, M.; Tuyn, J.W.N. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 253-261 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

A personal neutron monitoring system is presented which is based on the charged particle registration in a solid-state nuclear track detector (LR115 cellulose nitrate). In order to cover the wide neutron energy spectrum encountered around high-energy proton accelerators the track detector is used in contact with different radiators (boron, polycarbonate and bismuth). After etching, charged particles, such as alpha particles, create holes in the cellulose nitrate layer which are automatically counted with an image-analysing device (Quantimet). This paper presents the results of a large series of calibration and field tests around the CERN accelerators. It appears that an empirical formula for the neutron dose equivalent can be derived from the readings of the hole density under the boron and polycarbonate radiators that fits the conventional survey dose-equivalent measurements within acceptable limits for a wide variety of neutron spectra.

2405 **Application of liquid scintillation techniques to the assessment of low-level radioactivity.** Tschurlovits, M. (Atominstitut der Oesterreichischen Universitaeten, Vienna). pp 295-301 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

A brief description of techniques beyond the familiar application of liquid scintillation counting is presented in addition to a simple method for improving the lower limit of detection. The improvement of this limit for aqueous solutions can be performed easily by suitable selection of the composition of the sample. Examples of the optimization procedure for ^{3}H and ^{14}C are given. Pulse-shape techniques can be applied for discrimination of alpha and beta particles in a liquid scintillator. The principle of pulse-shape discrimination is described and the properties of this technique as well as further necessary development are discussed. Finally the evaluation of a possible neutron dose meter using liquid scintillation counting is very briefly described.

2406 **Air monitoring systems for alpha activities and for nuclide-specific noble gas measurements.** Mueller, S.; Kankowsky, R. (Frieseke und Hoepfner G.m.b.H., Erlangen (Germany, F.R.)). pp 329-342 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

Initially, the paper describes further development and improvement of a method of continuous measurement of very low alpha activities, e.g. those of plutonium and uranium in air, especially in the air of laboratory rooms or hot cells. It then describes a system of stack monitoring for nuclide-specific measurement of noble gases in the exhaust air of nuclear power plants.

2407 **Advances in alpha air monitoring instrumentation.** Valentine, A.M. (Los Alamos Scientific Lab., NM (USA)). pp 357-365 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

Early detection of airborne radioactive material is important for effective protection of workers, particularly at facilities handling high toxicity alpha-emitting radionuclides such as ^{238}Pu and ^{239}Pu. Variable levels of ever present and naturally occurring alpha-emitting radon daughters made gross alpha air monitoring systems unreliable for live-time monitoring of airborne plutonium. Hence, good live-time monitoring was not possible until an improved alpha air monitoring instrument capable of monitoring select plutonium radionuclides of concern was developed and marketed by nuclear instrumentation companies in the USA during the late 1960s and early 1970s. This monitoring instrument utilized a solid-state silicon-diffused junction type of detector and pulse-height analyser system to achieve a radon-daughter rejection capability. This rejection capability has resulted in an improved sensitivity for specific alpha-emitting radionuclides such as ^{238}Pu, ^{239}Pu and ^{241}Am. Current models of this instrument are capable of detecting 40 dis/min (0.65 Bq) of plutonium alpha activity.

2408 **Multielement alpha spectrometry. A new method for monitoring individuals and the working environment for actinide contamination.** Holm, E.; Persson, R.B.R. (Lund Univ. (Sweden). Radiofysiska Institutionen). pp 367-376 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979).

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

A method has been developed to provide easy separation of actinides from interfering bulk elements to enable alpha spectrometry measurements of several actinides to be made simultaneously. The samples are ashed and dissolved in 1M HNO_3-93% methanol solution. When this solution passes through an anion exchange column, the actinides are absorbed, while interfering elements pass through. The actinides are eluted with 0.5M HNO_3, electroplated from a $(NH_4)_2SO_4$ medium onto stainless steel discs and measured with silicon surface-barrier detectors. Pulse-height distributions obtained from various types of sample are illustrated. Low levels of sup(239+240)Pu are easily observed in soil samples. Lichen samples contain much more of fall-out sup(239+240)Pu and ^{241}Am than they do of the natural actinides. Reindeer-bone samples show high levels of ^{230}Th due to intake of ^{226}Ra with food and water. Sea water, sea-weed and sediment samples from outside a reprocessing plant show a high accumulation of transuranium elements in the sea-weed and sediment, but uranium still dominates in water.

2409 **Position sensitive proportional counter for x-ray applications.** Bubb, I. (Royal Melbourne Inst. of Tech. (Australia)); Tate, G. (Aeronautical Research Labs., Melbourne (Australia)). pp 13 of Australian Institute of Physics. 1st national conference on applied physics. Handbook and extended abstracts. Rockhampton, Australia; Capricornia Institute of Advanced Education (1979).

From 1. national conference on applied physics; Rockhampton, Australia (2 Jul 1979).

2410 **Application of position sensitive detectors to the measurements of residual stress by x-ray diffraction.** Coyle, R. (Aeronautical Research Labs., Melbourne (Australia)). pp 24 of Australian Institute of Physics. 1st national conference on applied physics. Handbook and extended abstracts. Rockhampton, Australia; Capricornia Institute of Advanced Education (1979).

From 1. national conference on applied physics; Rockhampton, Australia (2 Jul 1979).

2411 **Co-axial cylinder electron spectrometer.** Rajgara, F.A. (Tata Inst. of Fundamental Research, Bombay (India)). pp 293-294 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

An electrostatic electron spectrometer for energies upto 3 keV consisting of two coaxial cylinders has been developed. The spectrometer permits free access to both source and detector region by introducing potential shaping fringe plates at both the ends of the cylinders. For protecting the spectrometer from external magnetic fields, a double magnetic shield (Mu-metal) is used. With the inner and outer radii of the cylinders 56 mm and 119 mm respectively the calibration between the spectrometer deflection voltage U and the electron energy E, both expressed in volts is given by $E/U = 1.736$. The resolution obtained is 1.6% with electron energies from 100 to 3000 eV for 1.5 mm slits. A channel electron multiplier is used as a detector.

2412 **Portable and semi-portable high resolution gamma and x-ray spectrometers.** Blake, F. pp 78-80 of Second Australian conference on nuclear techniques of analysis. Proceedings. Lucas Heights, Australia; Australian Institute of Nuclear Science and Engineering (1978).

From 2. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (15 May 1978).

The availability of cooled hyperpure Germanium detectors (sometimes called HPGe detectors), for the detection of Gamma and X-rays, has made possible the development of small portable and semi-portable instruments suitable for X-ray fluorescence and Gamma spectrometry. The major characteristic of the HPGe detectors is that they may be cycled many times to room temperature without damage. Consequently, in the applications described, they are able to operate with a small resevoir of liquid nitrogen, sufficient to cover an 8 hour shift under working conditions.

2413 **X-ray measurements by means of the RGS-1M spectrometer.** Baskakov, A.V.; Derevitskii, Yu.G.; Enikeev, A.G.; Kocharov, G.E.; Lazutkov, V.P.; Matveev, G.A.; Naidenov, V.O.; Savchenko, M.I.; Sementsov, A.A. pp 231-239 of 9. Leningradskij seminar po Kosmofizike. Materialy seminara Solnechnye kosmicheskie luchi: generatsiya i vzaimodejstvie s veshchestvom ot istochnika do Zemli. Leningrad, USSR; Leningradskij Inst. Yadernoj Fiziki AN SSSR (1978). (In Russian)

From 9. Leningrad seminar on space physics; Leningrad, USSR (23 Dec 1977).

The PGS-1M spectrometer consisting of RSD-M and GSD-M units, and electronic units is described. The RSD-M unit is designed for continuous measurement of X-radiation from the Sun at 2-30 keV and comprises proportional counters. The GSD-M unit records X and gamma radiation at 20-200 keV and consists of two scintillation counters. The GSD-M permits to measure X-ray fluxes from solar flares and cosmic gamma-bursts to determine the angular direction component to the gamma-burst sources, and to investigate the time structure of the events. The spectrometer was installed on the "Prognoz-6" satellite; it operated for one month to record dozens of pulse flares of hard X radiation of solar origin.

2414 **Silicon mechanical processing effect on the surface-barrier detector characteristics.** Lashaev, S.I.; Solov'ev, S.M. pp 220-221 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The effect of grinding on the characteristics of surface-barrier detectors was studied with a view to selecting an optimum production process for manufacturng semiconductor silicon detectors. The characteristics of six detectors, which were finished with powders of electrocorundum with varying grain size are presented. An analysis of the results shows that, at room temperature and a 200 V bias, all the six detectors have reverse currents less than 1 μA and energy resolution of at least 40 keV. Thus, the resultant data do not permit to detect any association between the detector characteristics and the purity of mechanical treatment.

2415 **Temperature dependences of the charge losses in Si(Li) (p-i-n) detectors.** Eremin, V.K.; Muminov, R.A.; Turebekov, U.Sh.; Shamagdiev, A.Sh.; Yafasov, A.Ya. pp 197-201 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The causes of charge losses in Si(Li)(p-i-n) detectors with working region thickness equal of 1 mm and area of 1.25 cm^2 are studied. The dependences of the average charge losses from reverse drift velocity of nonequilibrium carrirs were measured. An analysis of the results obtained shows that at fields from 500 to 5000 $Vxcm^{-1}$, carrier capture occurs preferentially in potential traps. The dependence of the average charge losses upon sample temperature was obtained to clarify the parameters of capture centres. The sample material was found to have two capture levels of nonequilibrium carriers, at T approximately equal to 111 and 147 K. An analysis of the calculation results for capture centre parameters has shown the second level (E_2=0.16 eV) to be the A-centre; the first level (E_1=0.14 eV) has a vacancy na. ture and is located in the upper half of the forbidden zone.

2416 **Analysis of complex β-spectra measured with a magnetic spectrometer.** Gromov, K.Ya.; Kretsu, T.; Kuznetsov, V.V.; Lizurei, G.I.; Gorozhankin, V.M.; Makarie, G. pp 59-96 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The influence of all possible effects leading to distortions of β-spectra is studied to substantiate the reliability and accuracy of measurements of β-spectra. The investigation was performed for an iron-free beta spectrometer with a toroidal magnetic field. Considered are factors caused by the spectrometer and contributing substantially to the distortion of measured β-spectra, e.g. thickness of substrate and source, efficiency of recording β-particles by a detector, background distribution and corrections for response function of the beta spectrometer. An analysis of the resultant data shows that when measuring β-spectra at energies exceeding 150 keV one should pay special attention to backscattering in the source substrate to the real response function of the spectrometer, and to background conditions.

2417 **Radioactive nuclide radiation spectrometry by means of semiconductor detectors. Standards of energies and γ-quanta relative intensities.** Vylov, Ts.; Aleksandrov, V.S.; Vylova, L.A.; Gorozhanin, V.M.; Novgorodov, A.F.; Omanov, Sh.; Osipenko, B.P.; Fominykh, M.I.; Chumin, V.G.; Yurkovski, Ya. pp 3-42 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The method for precision measurements of the energies and relative intensities of γ-quanta by means of semiconductor detectors is described. Considered is in detail the procedure of constructing a complete set of standards for energies of spectrometric γ sources (SSGS) in the range from 260 to 3500 keV. ^{182}Ta and ^{192}Ir γ-quantum energies, measured by a crystal-diffraction spectrometer were used as energy standards in the 31-820 keV range. The energies and relative intensities of γ quanta of radioactive nuclides used for calibrating spectrometers were measured by means of five activity-calibrated SSGS sets. The following data on radioactive sources are tabulated: activity measurement error, γ-quantum yield per 100 decays, minimum error obtainable when measuring the spectrometer efficiency. With reference to minimum possible systematic errors, special attention is given to measurement conditions. The results for over 3000 instrumental spectra are given.

2418 **Dependence of the shape of the instrumental line of a magnetic spectrometer on its ion-optical and design parameters. Point source. Pt. 2.** Novikov, I.A.; Saulit, V.R. pp 97-133 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

A new method for constructing the instrumental line of a magnetic spectrometer is developed. The method takes account of the real character of an experiment, i.e. the fact that the line is formed while the magnetic field in the instrument changes. A detailed study of the dependence of the shape of the instrumental line in a magnetic spectrometer with focusing upon diaphragm number and arrangement is carried out. Rational arrangement of diaphragms in a magnetic spectrometer with focusing is shown to provide two-fold and, in some cases, fourfold increase of resolution as compared with a similar instrument with classical diaphragm arrangement. The examples of practical application of the above method for constructing the instrumental line are given.

2419 **Proportional chambers for charged-particle mass separation.** Konin, A.D. pp 134-140 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

Developed is a facility with three-plane multiwire proportional chambers (PC) for measuring ionization losses meter for measuring the total energy E. The facility is designed to identify protons, deuterons and tritons in the 3-70 MeV energy range, along with flight muons and decay electrons with energies of up to 52 MeV. Methane was used as the working gas in PC. Under 1 atm and 5.4 kV at the wires, gas amplification was equal to 10^2. In manufacturing PC, much attention was given to the accuracy of geometric dimensions. The use of PC for detecting charged particles provides for a full utilization of the muon beam in the muon channel of a synchrocyclotron, since the PC working area is determined by an input collimator, dia 90 mm. PC energy resolution determined by neutron capture on ^{3}He nuclei ammounts 5%.

2420 **Pulse shaper for scintillation detectors with NaI(Tl) or CsI(Tl) crystals.** Novisov, B.S.; Maksimenko, A.S.; Baryshev, A.V.; Zhukov, A.V. pp 222-226 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The basic circuit of a signal shaper for scintillation detectors with NaI(Tl) and CsI(Tl) crystals is described. To increase amplitude resolution, it is suggested to integrate not the whole charge at the photomultiplier output, but a part of the charge during the initial 100 ns of the current pulse; the remaining part of the current signal is compensated directly at the photomultiplier anode by means of an electric circuit. The principal elements of the spectrometric signal shaper include an input transistor amplifier, a compensation circuit, a key element, a shaper amplifier of time pulses, a shaper of signal duration for controlling the key element, and an output spectrometric amplifier. This device, being used, one can shape pulses at durations of 100 ns and more. The shaper restoration time does not exceed 50 ns. When the shaper operates with NaI(Tl) crystals and at counting rate of 10^6 pulse/s, the amplitude resolution with and without the compensation circuit is 17% and 21% respectively.

2421 **Calculation of the pulse shape of a cylindrical proportional counter in the case of extended ionization.** Khleskov, V.I.; Savel'ev, G.I. pp 165-168 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The theoretical expression is obtained for the pulse shape of a proportional counter; the pulse was caused by an ionizing particle track at arbitrary orientation, and at a given length. The calculations were performed for cylindrical proportional counters on the basis of the known logarithmic expression describing the output pulse of the counter at local ionization. It is also taken into consideration that primary ionization electrons drift independently from various sections of the track along radial lines towards the region of avalanche formation and independently form ion avalanches. Basing on the theoretical expression of computer calculations of pulse shapes were made for some tracks with similar energy release and different length, and orientation to an anode. The results obtained show that the orientation and lengths of ionizing particle track in proportional counters essentially affect the anode pulse front.

2422 **Shape of voltage pulse of the ionization detector with a uniform field.** Samedov, V.V.; Stolyarova, E.L. pp 174-179 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The formulae are obtained for determining the current and voltage components due to carrier motion in order to calculate the pulse shape in any ionization detector with a constant field. The calculations were performed for a plane-parallel detector with the assumption that ionization density along a track is constant and the charge generated by positive and negative charged particles is equal to Q. Various estreme cases are considered; for instance, the absence of charge loss and after carrier collection, the load voltage is equal to u(t)=Q/Csub(in), where Csub(in) is the total input capacitance.

2423 **Fast response of semiconductor p-i-n-detectors used in nuclear-physics experiments.** Evdokimov, V.M.; Zakharchuk, O.V.; Romanyuk, O.A.; Fedoseeva, O.P.; Borisova, N.A. pp 193-196 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The effect of traps on time properties of semiconductor detectors and on the pulse shape is considered. Analytical expressions are presented, by which the current pulse shape may be calculated depending on the following trap parameters: time of free path of electron and regeneration time of electron with trap. The calculation of the magnitude ΔT, is given which characterizes the delay of the charge pulse front. Theoretical and experimental dependences of ΔT upon the electron time-of-flight through the sensitive region t_0 are presented. A comparison of these dependences shows that the theoretical curve qualitatively correctly describes the experimental results. For large t_0, when electron density in traps is comparable with trap density, the problem becomes a nonlinear one.

2424 **Spectrometer for studying the (γ,π^-,p)-reaction.** Anan'in, P.S.; Glavonakov, I.V.; Gushtan, M.N.; Kashirin, A.P.; Stibunov, B.N. pp 160-164 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

A two-arm spectrometric facility for recording mesons and protons in the 40-190 MeV range was developed for studying (γ,π^-,p) reactions by detecting π-mesons in coincidence with protons knocked out from nuclei. The meson channel comprises a range multigap spark chamber and a telescope consisting of three scintillation counters. The solid angle of the meson channel is 26 msr. The spark chamber contains eighteen separate modules and a set of copper absorbers ensuring the detection of mesons in the 25-185 MeV range, spacing of 10 MeV. The storage time of the spark chamber filled with neon and at electric field of 30 $Vxcm^{-1}$ equals 1.5 Ms. The proton channel consists of two scintillation counters and has an angle of 2 msr. The amplitude resolution of the counters for 50-120 MeV protons equals 20-25%; this ensures reliable discrimination of protons on a background of electrons and pions. The accuracy of estimation of proton energy in the 50-190 MeV range is characterized by a root mean-square deviation equal to 3.1-10 MeV, and the root-mean-square deviation while determining pion energies in the 40-180 MeV range amounts 3.3-7 MeV.

2425 **Study on the high pressure discharge phenomena in nonuniform electric fields in some noble gas mixtures used as detection media.** Jagusztyn, W.; Ostrowski, K.W.; Rulikowska-Zarebska, E. (Akademia Gorniczo-Hutnicza, Krakow (Poland). Inst. Fizyki i Techniki Jadrowej). pp 717-718 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, Germany; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 1996, 2126, 2213, 2284, 2531

2426 **Method for determining the thermal diffusivity of liquids at elevated temperatures.** Etter, D.E. (Monsanto Research Corporation, Mound Facility, Miamisburg, Ohio 45342). *Review of Scientific Instruments;* **52**: No. 11, 1717-1720(Nov 1981).

A technique was developed for the determination of the thermal diffusivity of transparent, translucent, and opaque liquids at ambient and elevated temperatures. The inherent vaporization characteristics of the liquid under investigation dictate the temperature limitations of the technique. The method uses modifications of the laser flash technique previously established for measurement of the thermal diffusivity of solids. The accuracy of the technique is estimated to be +- 8.

2427 **Time-walk characteristics of an improved constant fraction discriminator.** Wozniak, G.J.; Richardson, L.W.; Maier, M.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nuclear Instruments and Methods;* **180**: No. 2/3, 509-510(1 Apr 1981).

A modification to a constant fraction discriminator design published earlier makes the observed time walk less than 30 ps over an input voltage range of 0.15 to 2.5 V. This performance makes time-walk corrections unnecessary in many situations.

2428 **High performance timing discriminator.** Sanders, G.H.; Hart, G.W.; Hogan, G.E.; Frank, J.S.; Hoffman, C.M.; Matis, H.S.; Sandberg, V.D. (Los Alamos Scientific Lab., NM (USA)). *Nuclear Instruments and Methods;* **180**: No. 2/3, 603-614(1 Apr 1981).

A high performance, low cost discriminator employing both the leading edge and constant fraction trigger techniques has been

developed. This hybrid design provides an experiment with the ultimate in on-line and off-line resolution. The discriminator has been developed for use with a large modular detector using both NaI(Tl) and plastic scintillators.

2429 **Videofluorometry applied to the analysis of PAH components.** Seizinger, D.E. (Bartlesville Energy Technology Center, OK). pp 307-315 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper describes the general design and operation of the videofluorometer (VF) built at the Bartlesville Energy Technology Center for the purpose of measuring PAH. Some data reduction techniques for multicomponent analyses using VF are described along with future applications of this instrumentation. (KRM)

2430 **Remote sensing of PAH by laser induced fluorescence.** Dick, R. (Barringer Research Ltd., Rexdale, Ontario); Till, S.M.; O'Neil, R.A. pp 731-740 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper reports on some of the results obtained with a fully operational airborne laser fluorosensor, and describes its performance over a series of marine oil spills and fluorescent dyes. In this technique, an airborne laser illuminates a small area on the ground, and fluorescence induced by the laser radiation is mointored through a telescope by an optical receiver also situated on the aircraft. The results clearly demonstrate the feasibility of the present system for remotely monitoring PAH. (KRM)

2431 **Respirator protection factors. Part II. Protection factors of supplied-air respirators.** Hack, A.L.; Bradley, O.D.; Trujillo, A. (Los Alamos Scientific Lab., NM). *American Industrial Hygiene Association Journal;* No. 41, 376-381(May 1980). Contract W-7405-ENG-36.

Protection Factors provided by 25 NIOSH approved supplied-air respirators were determined while the devices were worn by a panel of test subjects anthropometrically selected to represent adult facial sizes. Polydispersed DOP aerosol was used for respirator fit tests on continuous flow, demand, and pressure-demand respirators. Based on facepiece leakage measurements it appears that demand-type respirators should neither be used nor approved. The highest level of protection was provided by pressure-demand devices.

2432 **Technique for study on ion scattering by solids.** Mashkova, E.S.; Molchanov, V.A. pp 38-77 of Rasseyanie ionov srednikh ehnergij poverkhnostyami tverdykh tel. Moscow, USSR; Atomizdat (1980). (In Russian)

Main problems of the technique for study on ion scattering by solids are presented. On the basis of Gunterschulze-Moore condition main requirements to appparatus are formulated. Briefly described are some mann-monochromators used bor study on ion scattering by solids surfaces. The method of target cleaning by sputtering under the action of bombardment by heavy ions of inert gases is described. Briefly presented are the methods of the analysis of irradiated surface in the course of the experiment-Auger spectrometry method low-energy electron diffraction (LEED) and analysis of surface on ion scattering (ISS-ion scattering spectroscopy). Described is the technique of analysis and recording of ion and neutral components of the scattered flow-magnetic and electrostatic analysers, analyzers of neutral particle energy and scattered particle total flow. Presented are the recording devices. Faradey cylinder, ion-electron converter, fast particle detector. The technique of measurement rebults processing is described.

2433 **Inspection of austenitic butt welds by longitudinal ultrasonic waves.** Hudgell, R.J.; Seed, H. (UKAEA Risley Nuclear Power Development Labs.). pp 269-276 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

This paper discusses the longitudinal wave ultrasonic inspection of manual metal arc austenitic butt welds. It is demonstrated that the direction and width of longitudinal wave beams are governed by a beam skewing phenomenon which is due to the anisotropic properties of the weld metal. The implications of this phenomenon on the inspection and fabrication of such welds are discussed. Some practical work is also presented on the inspection of deliberately defective austenitic welds, and as special cases, the longitudinal and shear wave inspection of welds with a very narrow preparation are also discussed.

2434 **Continuous monitoring of fatigue crack growth in pressure vessels by acoustic emission.** Lucia, A.C.; Franchi, M.; Galli, M. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Marozzi, C.A.; Terranova, A.; Vergani, L. (Politecnico di Milano (Italy)). pp 345-353 of Fourth international conference on pressure vessel technology. Volume 2. Design, analysis, components, fabrication and inspection. London, England; Mechanical Engineering Pubs. Ltd., for the Institution of Mechanical Engineers (1980).

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The results of a research work aimed at the detection of fatigue crack formation and propagation in the nozzles of pressure vessels are here presented. The on-line continuous monitoring during fatigue cycling was made by acoustic emission. The AE signals supplied an immediate information on the progressive degradation of the structure. Preservice and periodic inspections of the vessel were also made by ultrasonics, X-rays and laser interferometry. Their indications were in quite good agreement with those supplied by AE.

2435 **Application of small stationary electron probes to the study of mineral mixtures.** Dowell, W. (Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical Physics). pp 31 of Australian Institute of Physics. 1st national conference on applied physics. Handbook and extended abstracts. Rockhampton, Australia; Capricornia Institute of Advanced Education (1979).

From 1. national conference on applied physics; Rockhampton, Australia (2 Jul 1979).

2436 **Effect of initial material on the electrolytic parameters of field-effect transistors.** Antonov, A.V.; Sinitsyn, V.N.; Fursov, V.V. pp 209-212 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

The effect of initial material parameters upon the main electric characteristics of field transistors at room and optimum (170 deg C) temperatures is studied. For that purpose, the values of parasitic resistances rsub(s), specific resistances rho and steepness S of field transistors, depending on temperature and electrical conditions were measured. The output volt-ampere characteristics of the transistors at room and optimum temperatures are given. An analysis of the results obtained permits to conclude that there is an unambiguous relationship between rho and rsub(s). Impact ionization is shown to occur for field transistors with lower rho at lower drain voltage. When manufacturing field transistors designed for operation at low temperatures, one should remember that a minimum rho may restrict maximum possible steepness. When designing field transistors with optimum noise characteristics, one should variate not only such material parameters as mobility and carrier density, but also select optimum geometry.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

2437 Dependence of boundary-layer shear on diurnal variation of stability. Heald, R.C.; Mahrt, L. (Department of Atmospheric Sciences, Oregon State University, Corvallis, 97331). *Journal of Applied Meteorology;* **20**: No. 8, 859-873(Aug 1981).

Boundary-layer data from several different geographical locations are analyzed to document the behavior of boundary-layer shear above the surface. The influence of diurnal variation of stability is emphasized. The applicability of the power law for use in shear estimates is examined.

2438 Characteristics of local winds in northwest Hawaii. Schroeder, T.A. (Department of Meteorology, University of Hawaii, Honolulu 96822). *Journal of Applied Meteorology;* **20**: No. 8, 874-881(Aug 1981).

During the period 22—29 June 1978, meteorological data were collected at six stations arranged in nearly linear transection extending from the coast at Anaehoomalu, Hawaii to Waimea Airport, 25 km inland and 800 m higher. Sea breeze response to synoptic-scale weather patterns was documented.

5001 Basic Studies

REFER ALSO TO CITATION(S) 2491

2439 Climatology of transport and diffusion conditions along the United States Atlantic and Gulf coasts. Raynor, G.S.; Hayes, J.V. (Atmospheric SciEnces Division, Department of Energy and environment, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Meteorology;* **20**: No. 8, 882-889(Aug 1981).

A study of the atmospheric transport and diffusion climatology of the United States east and Gulf coasts was conducted to aid in planning and site selection for potentially polluting installations. This paper presents selected results from an extensive statistical study. Regular hourly observational data were obtained from 30 coastal stations from Maine to Texas and analyzed in terms of conditions important to emission transport and diffusion. The 30 stations included four pairs with one of each pair at a greater distance from the coast than the other but near the same latitude.

2440 Effects of sky brightness distribution upon penetration of diffuse radiation through canopy gaps in a deciduous forest. Hutchison, B.A.; Matt, D.R.; McMillen, R.T. (National Oceanic and Atmospheric Administration, Oak Ridge, TN). *Agricultural Meteorology;* **22**: 137-147(1980).

The penetration of diffuse sky randiation via canopy opening into a fully-leafed tulip poplar forest was estimated from canopy structure data obtained from canopy photographs and from sky brightness distribution approximations, using techniques originally developed by Anderson (1964). Small differences were found among mean daily penetration fractions predicted assuming an isotropic sky (UOC), a standard overcast sky (SOC), or an approxination of the weighted daily average predicted using a clear sky brightness distribution. For shorter time periods, penetration of diffuse radiation estimated using the UOC and SOC approximations differed substantially from estimates made using the clear-sky brightness distribution. Most diffuse radiation passes through openings that are within 10 degrees of the solar disk. Hence the directional distribution of diffuse radiation in the forest is strongly controlled by solar position on clear to partly cloudy days. Amounts of diffuse radiation observed in the forest under clear skies agree fairly well with those predicted by the model developed by Reifsnyder et al. (1971). In both cases, penetration increases with increasing solar elevation on clear days. We conclude that the SOC assumption produces acceptable results for time periods of a day or longer, but for shorter times with clear skies the use of the clear sky brightness distribution is necessary for most simulation or prediction modeling.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 2220, 2313, 2513, 2598, 2613

2441 (EPRI-EA—1910-Vol.2) Aircraft data summaries for the SURE intensives. Final report. Blumenthal, D.L.; Tommerdahl, J.B.; McDonald, J.A.; Strong, R.B.; White, J.H. (Meteorology Research, Inc., Santa Rosa, CA (USA); Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1981. 169p. NTIS, PC A08/MF A01. Order Number DE82900313.

As part of the EPRI sulfate regional experiment (SURE), Meteorology Research, Inc., (MRI) and Research Triangle Institute (RTI) conducted six air quality sampling programs in the eastern United States using instrumented aircraft. This volume includes the air quality and meteorological data obtained during the October 1977 Intensive when MRI sampled near the Rockport, Indiana, SURE Station and RTI sampled near the Scranton, Pennsylvania, SURE Station. Sampling data are presented for all measured parameters.

2442 (INIS-mf—6542, pp vp) Optical properties of a beam reflected through a turbulent atmosphere. Bensimon, D.; Englander, A.; Shtrikman, S.; Slatkine, M.; Treves, D. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Electronics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2443 Oxygen-18 study of the aqueous-phase oxidation of sulfur dioxide. Holt, B.D.; Kumar, R.; Cunningham, P.T. (Argonne National Lab., IL (USA)). *Atmospheric Environment;* **15**: No. 4, 557-566(1981).

An isotopic study of the aqueous-phase oxidation mechanisms of formation of sulfates from SO_2 was made in laboratory experiments by varying the oxygen-18 content ($\gamma^{18}O$) of the SO_2 and the water, and by varying the catalyst, the oxidant, and the order of combination of the SO_2 with air and water. In all of the experiments, the $\gamma^{18}O$ of the sulfate product was linearly dependent upon the $\gamma^{18}O$ of the water. The results indicate very rapid oxygen-isotope exchange between S(IV) ions and water prior to oxidation to S(VI). Charcoal catalysis of aqueous-phase air oxidation of SO_2 yielded sulfates of significantly lower $\gamma^{18}O$ than did Fe^{3+} catalysis. By a different mechanism, aqueous H_2O_2 oxidation of SO_2 yielded sulfates of much lower $\gamma^{18}O$ than air oxidation. A comparison of these results with the $\gamma^{18}O$ of sulfates found in precipitation water (rain and snow), collected over a three-year period at Argonne, Illinois, indicate that some other mechanism, in addition to aqueous air oxidation, is operative in the atmosphere.

2444 Ambient PAH levels near a steel mill in northern Ontario. Potvin, R.R. (Ontario Ministry of the Environment, Sudbury); Adamek, E.G.; Balsille, D. pp 741-753 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper presents the results of a PAH monitoring program carried out in the vicinity of a steel mill in northern Ontario during the period 1971 to 1979. The surveys of PAH compounds show that these compounds are present in significant concentrations at distances of less than 2 km from the mill. Investigations of the PAH distribution with particle size revealed that about 66% of BaP, as well as of other PAH compounds, was associated with respirable airborne particulates, thus increasing the health hazard associated with these compounds. (KRM)

2445 Industrial hygienic measurments of polycyclic aromatic hydrocarbons in foundries. Schimberg, R.W. (Inst. of Occupational Health, Helsinki, Finland). pp 755-762 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper presents the results of a study of PAH in air samples from a pilot plant foundry and in airborne particulate matter from six iron foundries. Qualitative analyses of the air and airborne matter in iron foundries show that the workers are exposed to a large range of known carcinogenic and cocarcinogenic PAH. The results of BaP measurements in different particle size fractions of airborne dust indicate that over 80% of the BaP is associated with the respirable dust fraction with particle size below 5 μm. (KRM)

2446 **Assessment of the environmental emissions from a utility boiler firing beneficiated coal-oil mixtures.** Whaley, H. (Energy, Mines and Resources Canada, Ottawa); Lee, L.K.; Doiron, C.C. pp 1.1-1.16 of Characterization and control of utility emissions. Pittsburgh, PA; Air Pollution Control Association (1980).

From Air Pollution Control Association annual meeting; Montreal, Canada (Jun 1980).

Environmental impacts of coal-oil mixtures as boiler fuel for thermal power plants are reported from demonstration program observations. Variations from 11 to 13 wt % of coal were tested. Sulfur content varied from 6 to 10 wt % and ash content ranged from 18 to 30 wt %. Results are summarized for stack emission from 3 firing modes as well as for control mode. Flyash emissions were reduced by 50% and sulfur oxides reduced by 10%. (PSB)

2447 **Chemical transformations of particulate polycyclic organic matter.** Hughes, M.M. (Colorado State Univ., Fort Collins); Natusch, D.F.S.; Taylor, D.R.; Zeller, M.V. pp 1-8 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The chemical reactions of two polycyclic aromatic hydrocarbons absorbed onto different substrates with several gases known to exist in the plumes of fossil fuel combustion and conversion processes were studied. It was observed that both the gas and the particulate surface significantly affected the reactions. (JR)

2448 **Separation and identification of sulfur heterocycles in coal-derived products.** Lee, M.L. (Brigham Young Univ., Provo, UT); Willey, C.; Castle, R.N.; White, C.M. pp 59-73 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980). Contract AC02-79EV10237.

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

A description of the analytical methodology for the separation and identification of sulfur heterocycles in complex aromatic mixtures is provided. The methods are described as applied to the analysis of coal gasification tars. (JR)

2449 **Changes in PAH-profiles in different areas of a city during the year.** Grimmer, G.; Naujack, K.W.; Schneider, D. (Biochemical Inst. for Environmental Carcinogens, Ahrensburg, Germany). pp 107-125 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

An investigation was done in order to compare local concentrations of several polycyclic aromatic hydrocarbons in some selected areas of an industrial city. Polycyclic aromatic hydrocarbon profiles in five areas, surrounded by four measuring stations each, were investigated weekly from October 1978 to March 1979. (JR)

2450 **Analysis of polynuclear aromatic hydrocarbons on the airborne particulates of urban New Jersey.** Greenberg, A.; Yokoyama, R.; Giorgio, P.; Cannova, F. (New Jersey Inst. of Tech., Newark). pp 193-198 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The New Jersey Institute of Technology Air Pollution Laboratory is engaged in a program of monitoring selected sites in New Jersey for air pollutants once every six days. Samples are analyzed in order to obtain air profiles throughout New Jersey to aid in epidemiological studies, pinpoint sources of pollutants, and evaluate pollution from events such as chemical warehouse or landfill fires. (JR)

2451 **Real-time analysis of gas phase polycyclic aromatic hydrocarbons using a mobile atmospheric pressure chemical ionization mass spectrometer system.** Lane, D.A.; Sakuma, T.; Quan, E.S.K. (SCIEX, Inc., Thornhill, Ontario). pp 199-214 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Application of the ultrasensitive APCI-MS technology to the analysis of vapor phase polycyclic aromatic hydrocarbons was studied. The purpose is directed at attempting to eliminate the current methods of time and manpower consuming techniques, and to eliminate all sample manipulation procedures. (JR)

2452 **Analysis of PAH in environmental samples by high temperature stable glass capillary columns.** Meuser, J.M.; Moore, F.R.; Strup, P.E.; Wilkinson, J.E.; Bjorseth, A. (Battelle, Columbus Labs., OH). pp 405-415 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

With the complexity and importance of polycyclic aromatic hydrocarbons in the environment, sampling and the availability of a highly efficient and sensitive analytical technique is needed. A discussion of glass-capillary gas chromatography, utilizing thermostable columns, appears to satisfy requirements needed in analytical techniques. (JR)

2453 **Problem of PAH degradation during filter collection of airborne particulates: an evaluation of several commonly used filter media.** Lee, F.S.C.; Pierson, W.R.; Ezike, J. (Ford Motor Co., Dearborn, MI). pp 543-563 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Evidence shows the extensive dark oxidation of filter-collected PAH does occur on most filter types; that the filter medium itself assumes a leading role in this degradation; that atmospheric reactions need not be invoked to explain the presence of direct-acting mutagens; and that lightly loaded filters are especially susceptible to dark oxidation reactions. (DLS)

2454 **Comparison of SIM GC/MS and HPLC for the detection of polynuclear aromatic hydrocarbons in fly ash collected from stationary combustion sources.** Zelenski, S.G.; Hunt, G.T.; Pangaro, N. (GCA, Bedford, MA). pp 589-597 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The two most commonly employed analytical methods for PAH are selected ion mass spectrometry (SIMS), coupled with capillary gas chromatography (CGC) and high performance liquid chromatography (HPLC) coupled with fluorescence and/or ultraviolet detection. A comparison of the two methods using four different combustion fly ash samples was initiated and found HPLC with fluorescence detection to have comparable resolution and increased sensitivity over GC/MS. (DLS)

2455 Use of PAH tracers during sampling of coal fired boilers. Sonnichsen, T.W. (KVB, Inc., Tustin, CA); McElroy, M.W.; Bjoerseth, A. pp 617-632 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Discussed are the results of PAH tracer evaluations and potential reasons for the relatively poor recovery levels observed when PAH tracers were injected into the sampling train concurrent with collection of real samples. Quantification of PAH emissions from coal-fired utility boilers and influences determined by several operational factors on emissions are discussed. (DLS)

2456 Liquid chromatographic determination of benzo(a)pyrene in diesel exhaust particulate: verification of the collection and analytical methods. Swarin, S.J.; Williams, R.L. (General Motors Research Labs., Warren, MI). pp 771-790 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

A rapid, reliable, and sensitive method for the determination of BaP in diesel exhaust particulates is described. The detection limit of the method is 5 pg/injection or 200 pg/filter, and the range is to 3000 ng/filter. The chromatographic analysis and detection have been verified by fluorescence scanning and analysis of spiked samples. (DLS)

2457 Normal- and reverse-phase liquid chromatographic separations of polycyclic aromatic hydrocarbons. Wise, S.A.; Bonnett, W.J.; May, W.E. (National Bureau of Standards, Washington, DC). pp 791-806 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The retention data for over 80 PAH on two C_{18} columns with different selectivity and on an amino silane (NH_2) column are reported. (DLS)

2458 Volatility of PAH and possible losses in ambient sampling. Lao, R.C.; Thomas, R.S. (Environment Canada, Ottawa, Ontario). pp 829-839 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

This study is designed to assess the possible loss of PAH by vaporization and to highlight some basic problems in the application of the high-volume sampling techniques for PAH. (DLS)

2459 Solvent extraction of polynuclear aromatic hydrocarbons. Robbins, W.K. (Exxon Research and Engineering Co., Florham Park, NJ). pp 841-861 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The general extraction characteristics of PAH have been established by the determination of the distribution coefficients in a number of extraction systems. The results of parameter studies demonstrate that the PAH as a group respond systematically to changes in extraction conditions. (DLS)

2460 Sensitized fluorescence detection of PAH. Smith, E.M.; Levins, P.L. (Arthur D. Little, Inc., Cambridge, MA). pp 973-982 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The laboratory and field tests obtained with the sensitized fluorescence spot test show it to be a simple, sensitive, and reliable method for PAH detection. Use of the spot test as a prescreen can eliminate the need for costly GC/MS analysis when no PAH are present. (DLS)

2461 Fluorescence spectroscopic properties of carcinogenic and airborne polynuclear aromatic hydrocarbons. Heinrich, G.; Guesten, H. (Kernforschungszentrum Karlsruhe, Germany). pp 983-1003 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Reported are basic photophysical data (absolute fluorescence spectrum, fluorescence quantum yield, and decay time) of a sizable number of airborne and carcinogenic PAH. (DLS)

2462 Recent developments in matrix isolation spectroscopic analysis of polynuclear aromatic hydrocarbons. Wehry, E.L.; Mamantov, G.; Hembree, D.M.; Maple, J.R. (Univ. of Tennessee, Knoxville). pp 1005-1023 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

In matrix isolation spectroscopy, samples are vaporized and mixed thoroughly with a large excess of diluent matrix gas; the resulting gaseous mixture then is deposited as a solid at cryogenic temperatures for subsequent spectroscopic measurements. Three recent innovations of MI are discussed which enhance the analytical capabilities of MI. (DLS)

2463 Submicron size distributions of particulate polycyclic aromatic hydrocarbons in combustion source emissions. Miguel, A.H.; Ruebenich, L.M.S. (Universidade Federal do Rio de Janeiro, Brazil). pp 1077-1083 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Recent reports on the size distribution of PAH with respect to particle size have shown some toxic species to predominate in small particles in urban aerosols and in small particles emitted from combustion sources. The distribution of PAH in the respiratory system, transport, and lifetime of PAH in the atmosphere are dependent on their particle size distribution. (DLS)

2464 Measurement and environmental impact of PAH: some closing remarks. Jones, P.W. (Electric Power Research Inst., Palo Alto, CA). pp 1085-1090 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

A review of the environmental impacts of PAH with emphasis on PAH monitoring and sampling, and chemical analysis. (DLS)

2465 Effects of rocket exhaust products in the thermosphere and ionosphere. Zinn, J.; Sutherland, C.D. (Los Alamos Scientific Lab., NM). *Space Solar Power Review;* **1**: 109-132(1980).

This paper reviews the current state of our understanding of the problem of ionospheric F-layer depletions produced by chemical effects of the exhaust gases from large rockets, with particular emphasis on the Heavy Lift Launch Vehicles (HLLV) proposed for use in the construction of solar power satellites. The second stage engines deposit 9×10^{31} H_2O and H_2 molecules between 74 and 124 km. Model computations show that they diffuse gradually into the ionospheric F region, where they lead to weak but widespread and persistent depletions of ionization and continuous production of H atoms. The orbit circularization burn deposits 9×10^{29} exhaust molecules at about 480-km altitude. These react rapidly with the F2 region O^+ ions, leading to a substantial (factor-of-three) reduction in plasma density, which extends over a 1000- by 2000-

km region and persists for four to five hours. For purposes of computer model verification, we include a computation representing the Skylab I launch, for which observational data exist. The computations and data are compared, and the computer model is described.

2466 **Instantaneous global ozone balance including observed nitrogen dioxide.** Solomon, S.; Johnston, H.S.; Kowalczyk, M.; Wilson, I. (Univ. of California, Berkeley). *Pure and Applied Geophysics;* **118**: 58-85(1980). Contract W-7405-ENG-48.

The catalytic destruction of stratospheric ozone by the oxides by nitrogen is believed to be an important part of the global ozone balance. The lack of sufficient measurements of NO/sub x/ concentrations has impeded efforts to quantify this process. Recent measurements of stratospheric nitrogen dioxide from ground-based stations as well as aircraft and balloons have provided a first approximation to a global distribution of NO_2 vertical columns at sunset. These observed vertical columns have been translated into time-dependent vertical NO_2 profiles by means of a one-dimensional atmospheric photochemical model. Using recent observations of air temperature and ozone along with this information, the independent instantaneous (one second) rates of ozone production from oxygen photolysis, P(O_3), of ozone destruction from pure oxygen species (Chapman reactions) L(O/sub x/), and of ozone destruction by nitrogen oxides L(NO/sub x/) were estimated over the three-dimensional atmosphere. These quantities are displayed as zonal average contour maps, summed over various latitude zones, summed over various altitude bands, and integrated globally between 15 and 45 km. Although the global summation between 15 and 45 km by no means tells the complete story, these numbers are of some interest, and the relative values are: P(O_3), 100; L(O/sub x/), 15; L(NO/sub x/), 45 +- 15. It is to be emphasized that this relative NO/sub x/ contribution to the integrated ozone balance is not a measure of the sensitivity of ozone to possible perturbations of stratospheric NO/sub x/; recent model results must be examined for current estimates of this sensitivity.

2467 **Simulated deposition rates for SO_2 on a southeastern US landscape.** Murphy, B.D.; Johnson, W.C.; Schlatter, E.C. (Oak Ridge National Lab., TN). *Agricultural Meteorology;* **21**: 179-193(1980).

Atmospheric transport and deposition of SO_2 are simulated over a circular area (22 km in radius) of representative landscape in East Tennessee. Data from aerial photographs were used to determine surface parameters which in turn allowed us to estimate deposition rates on the different ground cover types by taking account of both aerodynamic and surface related components of the process. Patterns of deposition rates are shown and
spatial patterns of ground cover type. Area averaged values of deposition velocity are deduced for representative times of the year. We speculate on the influence of various physical factors as they bear upon the perceived sensitivity of different species to SO_2 damage.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 2486

2468 (IAEA-TECDOC—228, pp 12-13) **Characterisation of aerosol produced in atomic energy industries and its application in monitoring and hazards evaluation.** Kotrappa, P. (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

The research work conducted in the framework of the IAEA's coordinated research programme presented techniques of aerosol production, measurements, dose evaluation to the nuclear workers in the working environment.

2469 (IAEA-TECDOC—228, pp 26-28) **Population dose occupancy due to external natural radiation in certain areas in Indonesia.** Roekmantara, R. (Bandung Reactor Center (Indonesia)). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

The average external dose received by the population around an active volcano proved to be slightly above the background of non-volcanic area. The population dose within the area of the radii 5-10km from the crater was determined by TLD. The highest and lowest annual population doses which are derived from the collective dose were about 527,6 mR and 2,4 mR, respectively.

2470 (INIS-mf—6528, pp 54-57) **Radioiodine monitoring system of the atmosphere in the environment of the Paks Nuclear Power Station.** Feher, I.; Biro, J.; Lancsarics, G.; Szabadi-Szende, G. (Koezponti Fizikai Kutato Intezet, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

For the continuous measurement of the radioiodine concentration in the environment of the Paks Nuclear Power Station two devices were developed: 1) High volume sampler for normal operating conditions. Its detection limit is 3 $mBqm^{-3}$ with NaI(Tl) detector and 0.3 $mBqm^{-3}$ with Ge(Li) detector. 2) Time integral of concentration of radioiodine measuring device with a detection range of 4 $Bqm^{-3}h$ - 4 $MBqm^{-3}h$. The paper deals with the testing of the adsorbent materials and devices.

2471 (INIS-mf—6528, pp 194-197) **Use of micro ion-exchange resin for environmental fallout sample analysis.** Ormai, P. (Paksi Atomeroemue Vallalat, Paks (Hungary)); Feher, I. (Koezponti Fizikai Kutato Intezet, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The recently developed technique which will be applied at the Paks Nuclear Power Station is being used extensively for routine fallout monitoring. The rainwater sample is concentrated on a few cm^3 of micro ionexchange resin then, without elution, the resin is analysed by gamma-spectrometry using a well-type NaI(Tl) detector. The detection limits of ^{131}I, ^{137}Cs and ^{144}Ce were 0.15 Bq (1.1 Bq/m^2), 0.17 Bq (1.3 Bq/m^2), and 0.48 Bq (3.6 Bq/m^2), respectively.

2472 **Parameter uncertainty and estimated radiological dose to man from atmospheric ^{131}I releases: a Monte Carlo approach.** O'Neill, R.V.; Gardner, R.H.; Hoffman, F.O.; Schwarz, G. (Oak Ridge National Lab., TN (USA)). *Health Physics;* **40**: No. 5, 760-764(May 1981).

Consideration is given to the implications of parameter uncertainty on the output of a mathematical model describing the atmospheric dispersion of ^{131}I, transport through the food chain into milk and the subsequent dose to the thyroid gland of infants resulting from milk ingestion. The approach used was a Monte-Carlo procedure which calculates the dose to the thyroid based on parameters whose values were randomly selected from a normal distribution about their means, stores the results and then repeats the process for other randomly selected parameter values. Predicted doses to the thyroid are log-normally distributed, with the mode strongly shifting to the left and a long tail extending to higher doses. Given parameter uncertainties, the present model predicts that it is possible to receive a dose that is an order of magnitude higher than the prediction obtained by inserting the mean value for each parameter into the model, i.e., the deterministic prediction.

5006 Regulations

REFER ALSO TO CITATION(S) 1757

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 2499

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 1799, 1803, 2472, 2499

2473 (IAEA-TECDOC—228, pp 11) **Ashing of environmental material for radioactivity measurements.** Sansoni, B. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

2474 (IAEA-TECDOC—228, pp 14-23) **Critical pathway studies for selected radionuclides.** Bhat, I.S. (Tarapur Atomic Power Station (India). Environmental Survey Lab.). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

The programme was carried out to determine the critical pathways for selected radionuclides /Co-60, Ni-63, Cr-51, Fe-55, Fe-59, Zn-65, Sn-113, Ag-110m, Ce-141, Ce-144, Mn-54, Ru-103, Ru-106/. The report deals with the following topics: 1) Determination of radionuclides in sea water, silt marine algae, marine organisms at Tarapur Atomic Power Station Site. 2) Concentration of radionuclides in air and food products in the terrestrial environment. 3) Demographic study to find dietary habits and consumption data. 4) Evaluation of critical exposure pathway.

2475 (IAEA-TECDOC—228, pp 58-69) **Measurement of radionuclides in environmental samples and items of diet at PINSTECH (1976-1977).** Mubarak, M.A. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Health Physics Div.). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

Sampling of environmental media such as air, water, precipitation, vegetation and some items of human diet was carried out at PINSTECH for the identification and measurement of various radionuclides in these samples. The procedures adopted for this purpose included rapid gamma spectrometric analysis for gamma emitters, liquid scintillation spectrometry for tritium and radiochemical separation for strontium-90. The radionuclides detected in the airborne particulate samples were cerium-141,144, ruthenium-103,106, zirconium-95/niobium-95, beryllium-7, cesium-137 and strontium-90. Barium-140/lanthanum 140 were also detected indicating fresh fallout from nuclear weapon tests. Atmospheric moisture, precipitation and potable water samples were also analysed for tritium. In addition various items of diet were analysed for Sr-90 as well as gamma emitting radionuclides.

2476 (IAEA-TECDOC—228, pp 70-73) **Assessment of wet ashing technique for biological materials.** Mubarak, M.A. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Health Physics Div.). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

Radiochemical analyses for trace quantities of radionuclides in biological materials require ashing of these samples. Conventional method of ashing such samples, i.e. dry-ashing is the most time-consuming and difficult operation and may involve appreciable loss of certain volatile radionuclides. A new method of wet ashing based on rapid dissolution of biological material by Fenton's reagent, H_2O_2/Fe^{++} was therefore assessed for adoption in place of dry-ashing. The method has been found to be well suited for routine work involving large quantities of samples and large sample numbers.

2477 (IAEA-TECDOC—228, pp 109-115) **Environmental radioactivity monitoring for radiation protection in Thailand.** Rativanich, N. (Office of Atomic Energy for Peace, Bangkok (Thailand)). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

Environmental radioactivity monitoring has been performed in Thailand since 1961. The present programme is planned for baseline evaluation studies in preparation for introducing nuclear power. Preliminary data are only presented for gross beta radioactivity of various environmental samples as the laboratory joined the co-ordinated investigations only recently.

2478 (IAEA-TECDOC—228, pp 29-32) **Investigations on the concentration levels of Sr-90 and Cs-137 in fresh milk produced in Indonesia.** Yatim, S. (National Atomic Energy Agency, Jakarta (Indonesia). Pasar Djumat Research Centre). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

Sampling programs have been designed and preliminary analysis on the concentration level of ^{90}Sr and ^{137}Cs in fresh milk have been done. After suitable radiochemical separation, ^{90}Sr is calculated by beta counting of the isolated ^{90}Y daughter and checked by following the decay of ^{90}Y. ^{137}Cs is isolated by absorbing on AMP and gamma counted using 2 x 2" NaI (TI) detector, and total concentration of Calcium is determined by Atomic Absorption Spectrophotometer. Results of preliminary samples show that ^{90}Sr level is 22 - 30 pCi/l, ^{137}Cs is 30 - 44 pCi/L and total calcium content is 1.15 - 1.30 g/L.

2479 (IAEA-TECDOC—228, pp 50-57) **Determination of radioactive contamination level in Korean foodstuffs.** Kang, Y.H. Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

This study was performed from July 1974 till May 1978 to observe the Sr-90 concentration in Korean foodstuffs which were grown in Central district, Honam district, Youngnam district and several islands districts: Ulnung I., Hucksan I. and Jeju I. The contamination levels in rice, barley, cultivated vegetables and wild edible vegetables in Korea were studied. The results obtained were as follows: in radiochemical determination of Sr-90 in rice and barley samples in 1977, it was estimated between 14,7+-7,3 and 58,1+-20,9 pCi/g Ca, and 15,7+-3,5 and 90,9+-41,8 pCi/g Ca, respectively. The average values of the rice samples and the barley samples were 34,2+-18,8 pCi/g Ca and 52,5+-30,8 pCi/g Ca. The Sr-90 concentration in the cultivated vegetable samples was 130,9+-2,1 pCi/g Ca and in the wild edible vegetable samples 221,6+-2,2 pCi/g Ca. The contamination levels in the various parts of the plants were as follows: 153,4+-2,0 in leaf, 310,2+-3,3 in root and 131,4+-3,8 pCi/g Ca in fruit.

2480 (IAEA-TECDOC—228, pp 85-104) **Cs-137 concentration in food items common to the Filipino dietary.** de la Cruz, B. (Philippine Atomic Energy Commission, Diliman, Quezon City). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final sum-

mary report on the IAEA's co-ordinated research programme between 1972 and 1978.

The present investigation aims to determine the level of Cs-137 in various food items common to the Filipino dietary, consisting of cereals, fish, meat, vegetables and fruits and to estimate the average dose commitment of the average Filipino adult resulting from the aforementioned radionuclide.

2481 (IAEA-TECDOC—228, pp 24-25) **Studies on the local environmental radioactivities in Indonesia.** Wiryosimin, S. (Bandung Reactor Center (Indonesia)). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

Radioactivity concentrations of 16 species of food raw materials were determined in the neighbourhood of the reactor centre. In addition, a comparison was made on samples of soil, vegetation and water. Measurements were also made on a few items from areas of active volcanos.

2482 (IAEA-TECDOC—228, pp 1-4) **Internationally co-ordinated research for environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. The outline of the six-years programme, 1972-1978.** Koeteles, G.J. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety and Environmental Protection). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

The history, scientific background and objectives of the six-years' programme are summarized. Data are given on the participation and organization. The main general results of the collaboration are listed. Based on the recommendations of the participants, notes are presented on the scientific and technical activities to be performed in the future, possibly in the framework of continued international collaboration.

2483 (IAEA-TECDOC—228, pp 5-10) **Radiation exposure and doses resulting from natural radioactivity in the environment and radioactive isotopes in food chains.** Rab Molla, M.A. (Atomic Energy Centre, Dacca (Bangladesh). Health Physics Div.). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

The investigations were carried out on the following main directions: environmental radioactivity in vegetables and soil of Bangladesh, influence of K on the uptake of Cs-137 by vegetable crops from soil, background radiation levels in Bangladesh including a recently discovered high natural background radiation area at Cox's Bazar beach. Experimental and measurement data are presented.

2484 (INIS-mf—6528, pp 91-95) **Mathematical model of tritium movement.** Horvath, L.G. (Villamosenergiaipari Kutato Intezet, Budapest (Hungary)); Miettinen, J.K. (Helsinki Univ. (Finland). Dept. of Radiochemistry); Fodorne Csanyi, P. (Eoetvoes Lorand Tudomanyegyetem, Budapest (Hungary). Fizikai Kemiai es Radiologiai Tanszek). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From NASA/AIAA workshop on aerospace applications of microprocessors; Greenbelt, MD, USA (3 Nov 1980).

A mathematical model has been developed to describe the movement of HTO in gravel. The best fitting diffusion coefficient (7.14×10^{-4} cm^2/s) found in gravel was one order of magnitude greater than the self-diffusion coefficient of water. The comparison of the theoretical and experimental results shows that their agreement is quite good while the activity is moving in the unsaturated zone. When it reaches the ground water table the conditions for the movement change and the agreement turns poorer.

2485 (INIS-mf—6528, pp 179-182) **Controlling of ^{131}I isotope contamination.** Molnar, J.; Padosne Farkas, E.; Toth, M. (Koezponti Fizikai Kutato Intezet, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

In the Institute of Isotopes of the Hungarian Academy of Sciences, the air from the ventilation system of hot cells for ^{131}I production is filtered before leaving the reactor chimney. According to measurements of several years, the annual average emission of ^{131}I is about 51 GBq. During spring and autumn 1979 the weekly emission of ^{131}I increased to 26 GBq. The report gives a survey on the observed variation of the emission as well as on the radioactive concentration values measured in fall-out and dry-out samples of soil and grass. It has been found that the degree of contamination due to ^{131}I is negligible from the point of view of environmental protection: it remained below the level measured following the Chinese nuclear tests in autumn 1977.

2486 **Role of radon in comparisons of effects of radioactivity releases from nuclear power, coal burning and phosphate mining.** Cohen, B.L. (Argonne National Lab., IL (USA); Pittsburgh Univ., PA (USA)). *Health Physics;* **40**: No. 1, 19-25(Jan 1981).

It is shown that radon emissions are the predominant source of radiation exposure from nuclear power, coal burning or phosphate mining. For very long time spans, erosion of the continents must be considered, and in this perspective bringing uranium to the earth's surface has no effect since it would eventually reach the surface anyhow, so coal burning and phosphate mining have no net effect; however, nuclear power saves lives by removing the radon source, the net effect ultimately being a saving of 350 lives/GWe-yr. If only effects over 500 yr are considered, lives saved by removal of uranium in mining exceed lives lost due to radon emissions from the nuclear industry under regulations now being instituted, and the net fatalities per GWe-yr caused by all radioactivity releases are 0.017 for nuclear vs 0.045 for coal burning; the effects of radioactivity releases by 1-yr of present annual operations are 10 times larger for phosphate mining than for coal burning.

5105 Site Resource And Use Studies

2487 **(P—700-81-016) Flora of the Mayacmas Mountains.** Neilson, J.A. (California Energy Resources Conservation and Development Commission, Sacramento (USA); Ecoview, Napa, CA (USA)). Sep 1981. 290p. California Energy Resources Conservation and Development Commission, Sacramento 95825. Order Number DE82900144.

This flora describes the plants that occur within the Mayacmas Mountain Range of northern California. It is the result of ten years of environmental assessment by the author in the Geysers Geothermal Resource area, located in the center of the Mayacmas Range. The flora includes notes on plant communities and ecology of the area, as well as habitat and collection data for most of the 679 species covered. Altogether 74 families, 299 genera and 679 species are included in the flora. The work is divided into eight subdivisions: trees; shrubs; ferns and fern allies; aquatic plants; tules, sedges, and rushes; lilies and related plants; dicot herbs; and grasses. Within each subdivision, family, genera and species are listed alphabetically. Keys are provided at the beginning of each subdivision. A unique combination of physical, environmental and geologic factors have resulted in a rich and diverse flora in the Mayacmas. Maps have been provided indicating known locations for species of rare or limited occurrence.

2488 **Effects of logging on macroinvertebrates in streams with and without buffer strips.** Newbold, J.D.; Erman, D.C.; Roby, K.B. (Univ. of California, Berkeley). *Canadian Journal of Fisheries and Aquatic Science;* **37**: No. 7, 1076-1085(1980). Contract W-7405-ENG-26.

The impact of logging with and without buffer strip protection on stream macroinvertebrates was examined through comparisons of community structure in commercially logged and control watersheds throughout northern California. A nonparametric test of community dissimilarities within matched blocks of two control and one or two treated stations showed significant ($P < 0.05$) logging

effects on unprotected streams when Euclidean distance and mutual information were used as dissimilarity indices, but not when chord distance was used. Shannon diversity in unprotected streams was lower ($P < 0.01$) than in control (unlogged) streams; densities of total macroinvertebrate fauna and of Chironomidae, Baetis, and Nemoura were higher in unprotected streams than in controls ($P < 0.05$). Streams with narrow buffer strips (<30 m) showed significant effects by the Euclidean distance test, but diversity varied widely and was not significantly different from that in either unprotected or control streams than in controls ($P < 0.05$). Macroinvertebrate communities in streams with wide buffers (≧ 30m) could not be distinguished from those of controls by either Euclidean distance or diversity; however, diversity in wide-buffered streams was significantly greater than in streams without buffer strips, indicating effective protection from logging effects.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

2489 (IAEA-TECDOC—229, pp 1-8) **Review on the 3 years of the coordinated research programme on "the problems of radioecology of the Danube River" 1976-1979.** Koeteles, G.J. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety and Environmental Protection). 1980. NTIS (US Sales Only).

In International studies on the radioecology of the Danube River 1976-1979. Report of the IAEA's co-ordinated research programme (1976 to 1979) on the problems of the radioecology of the Danube River.

The initial programme goals, as well as the organizational, scientific and technical achievements of the coordinated programme, are described. It is emphasized that the first 3 years of international collaboration could not solve all the problems as foreseen. The most important further tasks are summarized also, which can be fulfilled by continuing the collective work. General data on the historical background, on organization and on the financial aspects are given.

2490 **Bioassay study of effects of zooplankton, iron and NTA on the phytoplankton productivity of a marl lake.** Mitchell, S.F.; Wetzel, R.G. (Michigan State Univ., Hickory Corners). *Hydrobiologia;* **68**: No. 3, 235-241(1980). Contract AS02-76EV01599.

Additions of iron and NTA had minor stimulatory effects on the phytoplankton productivity of samples of water from two calcareous Michigan lakes in autumn and winter contrary to effects at other seasons. Added Daphnia pulex significantly reduced phytoplankton productivity by grazing at this time of year, in all tests at all levels of addition from 4-32 animals/l, greatly in excess of any possible beneficial effects of increased nutrient availability.

2491 **Evidence for deflection of the Gulf Stream at the Charleston rise.** Pietrafesa, L.J. (North Carolina State Univ., Raleigh); Blanton, J.O.; Atkinson, L.P. *Gulfstream;* **4**: No. 9, 3-7(Sep 1978). Contract AS09-76EV00902.

It has long been known that the Gulf Stream meanders laterally along the whole of the South Atlantic Bight (the continental margin between Capes Canaveral and Hatteras), but a quasi-permanent deflection of the Gulf Stream has recently been postulated offshore of Charleston, South Carolina. This supposition is supported by hydrographic data, nutrient data, and remotely sensed imagery of the sea surface topography.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 2247, 2499, 2580

2492 **Quantitative evaluation of priority pollutant polycyclic aromatic hydrocarbons at one part per billion using EPA recommended priority pollutant protocol.** Nowicki, H.G.; Kieda, C.A.; Bassett, D.O. (Calgon Corp., Pittsburgh, PA). pp 75-87 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

A summary of experimental findings from the evaluation of EPA recommended protocol to measure 13 of the priority pollutant polycyclic aromatic hydrocarbons is reported. The purpose of this study was to determine the application of this technique at the 1 ppb level rather than at the 10 ppb level as stated in the protocol. (JR)

2493 **Polynuclear aromatic hydrocarbons in Norwegian drinking water resources.** Olufsen, B. (Central Inst. for Industrial Research, Oslo, Norway). pp 333-343 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

In Norway, some 95% of the total drinking water supply is surface water. This makes the sources sensitive to atmospheric fallout of polynuclear aromatic hydrocarbons originating from local pollutant sources. Research presented here is aimed at a method generally applicable to any water sample and is tailored to suit separation and identification on glass capillary columns and flame ionization detection. (JR)

2494 **Polycyclic aromatic hydrocarbons in marine sediments, bivalves, and seaweeds: analysis by high-pressure liquid chromatography.** Dunn, B.P. (British Columbia Cancer Research Center, Vancouver). pp 367-377 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Relationships between levels of a range of polycyclic aromatic hydrocarbon isomers in three types of marine samples: sediments, bivalve mollusks, and seaweed were examined. (JR)

2495 **Tissue hydrocarbon burden of mussels from various sites around the Scottish coast.** Mackie, P.R.; Hardy, R.; Whittle, K.J.; Bruce, C.; McGill, A.S. (Ministry of Agriculture, Food and Fish, Aberdeen, Scotland). pp 379-393 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Bivalves such as mussels were used to monitor various marine pollutants including heavy metals, transuranic elements, petroleum hydrocarbons and halogenated hydrocarbons because of the alleged ability of bivalves to accumulate these and thus act as integrators of the input. Advantages of this approach would be the use of tissue analysis, which would replace the problems of large water samples for chemical analysis. (JR)

2496 **Comparison of extraction techniques for polynuclear aromatic hydrocarbon analysis of industrial effluents and natural waters.** Smillie, R.D.; Wang, D.T. (Ontario Ministry of the Environment, Rexdale). pp 863-877 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Four extraction techniques were evaluated for the analysis of PAH from industrial process streams and effluents, and from natural waters. The continuous liquid-liquid extraction technique is preferred over the liquid-liquid shake-out technique. (DLS)

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 2175, 2477

2497 **(CTOM—42367) Hydrogeochemical processes affecting the migration of radionuclides in a shallow ground water flow system at Chalk River Nuclear Laboratories.** Jackson, R.E. (Waterloo Univ., Ontario (Canada)). 1979. 150p. Canadian Theses on microfiche service, National Library of Canada, Ottawa, Canada K1A 0N4.

Thesis.

In the mid-1950s two experimental disposals of liquid radioactive waste containing approximately 700 curies of ^{90}Sr and ^{137}Cs were made into shallow pits dug into sandy soil in the Perch Lake basin at Chalk River Nuclear Laboratories. In the past 25 years the radioactive wastes have migrated and separated into ^{90}Sr and ^{137}Cs plumes, each moving at a characteristic velocity much less than the velocity of the ground water. In this study ground waters were sampled using piezometers distributed throughout the aquifer, and analyzed for pH, Esub(H:, O_2, Ssub((T::sup(2-:, alkalinity, and major ions. Contaminated sediments were obtained from various depths, and the sediments and interstitial waters separated. Most of the ^{90}Sr was found to be exchangeably adsorbed, primarily on feldspars and biotite; the remainder was either adsorbed to Fe(III: or fixed to unknown sinks. Less than half the ^{137}Cs was exchangeable with $CaCl_2$; the high levels of ^{137}Cs adsorption and fixation are believed due to its reaction with micas. In some parts of the aquifer the retardation of ^{90}Sr may be occurring due to the precipitaion of $SrCO_3$.

2498 (IAEA-TECDOC—219, pp 9-28) **Determination of Cs-137 and Sr-90 in the water of the Danube River.** Tschurlovits, M.; Buchtela, K.; Unfried, E. (Atominstitut der Oesterreichischen Universitaeten, Vienna); Sas-Hubicki, J. (Federal Institute of Water Quality, Vienna, Austria). 1979. Dep. NTIS (US Sales Only).

From 2. meeting to study questions of mutual co-operation between countries in the Danube Catchment Area; 1. research meeting on problems of radioecology of the Danube River; Bucharest, Romania (5 Dec 1977).

A programme for the regular measurements of the radionuclides in the Danube water samples was initiated. Samples of 25 litres were taken in Vienna and evaporated for gamma-spectroscopic measurements. The Cs-137 concentration was found to be between 0.02 and 0.15 pCi per litre. The Sr-90 and Y-90 were determined after radiochemical separation. The Sr-90 concentration was found to be between 0.064 and 1.76 pCi per litre. The influences of seasonally changing meteorological and hydrological conditions were noted.

2499 **Distribution of mercury, cesium-137, and plutonium in an intermittent stream at Los Alamos.** Hakonson, T.E.; White, G.C.; Gladney, E.S.; Dreicer, M. *Journal of Environmental Quality;* **9**: No. 2, 289-292(Apr 1980). Contract W-7405-ENG-36.

This paper summarizes the results of a study on the distribution of Hg, ^{137}CS, ^{238}Pu, and ^{239} ^{240}Pu in channel sediments and adjacent bank soils in an intermittent stream used for treated liquid effluent disposal since 1963. Concentrations of the three radionuclides and Hg in stream bank soils were comparable to adjacent channel sediments demonstrating that the stream bank serves as a deposition site for chemicals released to the channel. This finding has important implications on the long-term behavior of effluent contaminants since other studies at Los Alamos have shown that the vegetated stream banks retard downstream movement of chemicals bound to soils and provide a pathway for transport of these materials to biota. Concentrations of the radionuclides and mercury were more uniformly distributed with distance and depth in the channel sediments than in the bank soils.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 1772, 1773

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

2500 (AECL—6958, pp 149-186) **Health effects of electricity generation.** Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

State-of-the-art assessments of various methods of generating electric power on a unit plant basis are given. Using similar results, estimates are made of the health damage attributable to utility and industrial use of coal in the United States in 1975, and to be expected from coal production and use under the President's National Energy Plan (NEP) for 1985 and 1990.

2501 (AECL—6958, pp 323-324) **Risks of energy generation in perspective.** Cohen, B.L. (Pittsburgh Univ., PA (USA). Dept. of Physics). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

Life expectancy reduction (LER) figures due to various risks are given. The example, air pollution from coal burning gives an LER of 12 days, and nuclear power, by government estimates, gives an LER of 0.04 days. The 25-day LER from all our use of energy is placed in perspective by comparing equivalent risks from everday hazards. The logical assumsption that reducing energy consumption reduces the LER figure is shown to be false because lower energy consumption lowers per capita income, which in turn greatly reduces life expectancy of the population. Energy shortage also ultimately leads to greater unemployment which increases the rate of suicide and murder and so, again, decreases life expectancy.

2502 (AECL—6958, pp 237-243) **Role of radon in comparisons of effects of radioactivity releases from nuclear power, coal burning, and phosphate mining.** Cohen, B.L. (Pittsburgh Univ., PA (USA). Dept. of Physics). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

It is shown that radon emissions are the predominant source of radiation exposure from nuclear power, coal burning, or phosphate mining. For very long time spans, erosion of the continents must be considered and in this perspective bringing uranium to the earth's surface has no effect since it would eventually reach the surface anyhow, so coal burning and phosphate mining have no net effect; however, nuclear power saves lives by removing the radon source, the net effect ultimately being a saving of 350 lives/GWe-yr. If only effects over 500 years are considered, lives saved by removal of uranium in mining exceed lives lost due to radon emissions from the nuclear industry under regulations now being instituted, and the net fatalities per GWe-yr caused by all radioactivity releases are 0.017 for nuclear vs. 0.045 for coal burning; the effects of radioactivity releases by one year of present annual operations are 10 times larger for phosphate mining than for coal burning.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 1846, 2516

2503 **Power generation and the environment.** Robson, A. (Central Electricity Generating Board, London (UK)). pp 59-84 of Environmental quality. The industrial dimension. Proceedings of the seminar. Harwell, England; AERE (1981).

From Seminar on environmental quality, the industrial dimension; Harwell, UK (4 Jun 1980).

The subject is dealt with under the headings: the development, application and achievements of environmental protection procedures (with particular reference to the activities of the CEGB); the current environmental debate (plutonium toxicity; radioactive emissions from coal fired and nuclear power stations; sulphur dioxide, rain acidification and the consequences; fuel consumption, emission quantities and potential hazard); risk analysis; conclusions.

2504 (AECL—6958, pp 201-219) **Problems and pitfalls in the environmental assessment of energy systems.** Morris, G. (California State Senate Water Resources Committee, Sacramento (USA)). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

One of the most important reasons for wanting to understand the environmental effects of energy production is so that different energy systems can be compared on a consistent and meaningful basis. Unfortunately, the tools and data needed for comprehensive and commensurable environmental comparisons are not fully available. Even comparative studies that are limited in scope face many pitfalls due to lack of data and established methodologies. In 1978, world-wide attention was drawn to a report issued by Canada's Atomic Energy Control Board, which purported to have comprehensively and consistently compared a broad range of conventional and unconventional energy technologies. This report was based on a multitude of errors, but in critiquing it, many subtle pitfalls, too, were encountered. This conference report is based on the Energy Resources Group critique, and is an attempt to communicate some of the complexities and pitfalls that make comparative environmental assessment as challenging as it is important. The issues covered include: fuel cycles and the boundary problem, selection of appropriate systems and data, equivalence of energy forms, occupational and public risk, and integration of intermittent generating technologies into electric-utility grids.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

2505 **Microzooplankton interference with ATP estimates of plankton biomass.** Banse, K. (Univ. of Washington, Seattle). *Journal of Plankton Research;* **2**: No. 3, 235-238(1980). Contract AT06-76EV75026.

In oceanic and coastal water samples, half or more of the measured ATP may be of animal origin because metazoans have C/ATP ratios materially lower than the value of 250 usually applied in marine work, and because an appreciable metazoan biomass may remain in small samples after straining through a 0.2-mm mesh. The animals may thus lead to considerable overestimates of plankton biomass from ATP measurements.

2506 **Annual productivity and phytoplankton changes between 1968 and 1974 in Gull Lake, Michigan.** Moss, B.; Wetzel, R.; Lauff, G.H. (Michigan State Univ., East Lansing). *Freshwater Biology;* **10**: 113-121(1980). Contract EY-76-S-02-1599.

The seasonal and depth distributions of dominant phytoplankters, in situ primary productivity, organic carbon, and major chemical variables are described for Gull Lake, Michigan for the years 1971 through 1974. Despite efforts by residents surrounding this moderately large dimictic lake to reduce phosphorus loading, all indications are of progressive eutrophication pver the period. Previously dominant Cyclotella michiganiana has almost completely disappeared while araphidinean diatoms have increased greatly; certain blue-green algae that were absent previously are becoming characteristic. The ratio of araphidinean to centric diatoms in recent sediments has also increased. Primary productivity and particulate and dissolved organic carbon concentrations have also increased. Voluntary attempts to reduce nutrient loading have apparently been inadequate to arrest increasing rates of eutrophication.

5502 Biochemistry

REFER ALSO TO CITATION(S) 2521, 2543, 2544, 2593, 2594, 2600, 2601, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2614, 2615, 2617, 2618, 2619, 2620, 2621, 2623, 2626, 2627

2507 **Mechanisms of action of the type-I restriction endonuclease, EcoB, and the recBC DNase from Escherichia coli.** Rosamond, J.; Endlich, B.; Telander, K.M.; Linn, S. (Univ. of California, Berkeley). *CSH-Symposium;* **43**: vp([nd]).

We have been investigating two DNA-dependent ATPases from Escherichia coli, the type-I restriction endonuclease from E. coli B (EcoB) and exonuclease V (the recBC enzyme) of E. coli K12. This paper summarizes the results of our most recent studies of the mechanisms of action of these enzymes in vitro and attempts to relate these mechanisms to in vivo functions.

2508 (INIS-mf—6528, pp 232-235) **Measurement of the photolythic breakdown of HTO by determining the level of tritiated metabolites (formaldehyde, glycose) in maize leaves.** Szarvas, T.B.; Pozsar, B.I.; Simon, L.P. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

Earlier experiments undoubtedly indicate the presence of endogeneous formaldehyde, glycolaldehyde and glycerinaldehyde and its formation in maize leaf tissues, with the aid of dimedone treatment. The photolytic activity of the HTO breakdown was determined by means of fixing with liquid air, followed by ethylaether extraction and radiochromatographic separation. The breakdown of the HTO in the photolythic activity compared to the atomic exchange was lower by six order. Based on the experiments carried out with tritium and also on the measurements proving the presence of free formaldehyde a new possibility of carbon metabolism and photolysis pathway has been suggested in the early period of photosynthesis.

2509 **Kinetics of benzo[a]pyrene transfer between human plasma lipoproteins.** Smith, L.C.; Doody, M.C. (Baylor College of Medicine, Houston, TX). pp 615-624 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper presents the kinetics of benzo(a)pyrene transfer between human plasma lipoproteins. The mechanism of transfer of PAH involves rate-limiting desorption into the aqueous solution, followed by rapid uptake of PAH by the acceptor lipoprotein. Some of the biophysical factors that influence the kinetics of transfer of lipophilic materials between these lipoprotein surfaces are discussed. (KRM)

2510 **Manganic acetate and horseradish peroxidase/hydrogen peroxide: in vitro models of activation of aromatic hydrocarbons by one-electron oxidation.** Rogan, E.G.; Roth, R.; Cavalieri, E. (Univ. of Nebraska Medical Center, Omaha). pp 259-266 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Study of the binding of a series of polycyclic aromatic hydrocarbons to DNA catalyzed by the horseradish peroxidase/hydrogen peroxide system shows that the level of binding is influenced by the ionization potential of the polycyclic aromatic hydrocarbons. This represents a further indication that horseradish peroxidase activates polycyclic aromatic hydrocarbons by one-electron oxidation. The horseradish peroxidase/hydrogen peroxide oxidizing system can be used to form polycyclic aromatic hydrocarbon adducts with biological macromolecules in vitro, which can then be compared to polycyclic aromatic hydrocarbon adducts produced in vivo. (JR)

2511 **Benzo(a)pyrene radicals and other derivatives formed in interactions with cysteine/serum albumin.** Srinivasan, B.N.; Fujimori, E. (Boston Biomedical Research Inst., MA). pp 319-331 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980). Contract EE-77-S-02-4347.

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The interactions of benzo(a)pyrene with the SH-proteins, serum albumins, and cysteine can also produce other benzo(a)pyrene products as well as the radical species. Some benzo(a)pyrene products are firmly bound to a solution of bovine serum albumin in the dark, while photooxidized benzo(a)pyrene products are photobound to a greater extent. More information on benzo(a)pyrene-protein interactions and their role in carcinogenesis awaits further investigation. (JR)

2512 **Structure-carcinogenicity studies of polycyclic aromatic hydrocarbons: a pattern recognition approach.** Norden, B.; Edlund, U.; Wold, S. (Univ. of Umea, Sweden). pp 345-366 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The major purposes of these studies have been to clarify the mechanism of carcinogenic action of these compounds and to predict the biological activity based on the chemical structures of polycyclic aromatic hydrocarbons. (JR)

2513 **Chemical characterization of polynuclear aromatic hydrocarbons in airborne effluents from an experimental fluidized bed combustor.** Hanson, R.L.; Carpenter, R.L.; Newton, G.J. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). pp 599-616 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980). Contract EY-76-C-04-1013.

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

PAH have been quantitated and identified in particulate and vapor phase samples from an experimental fluidized bed combustor. Similar chemical analysis have been applied to fly ash collected by the effluent cleanup devices. In general; vapor phase PAH concentrations exceed particle-borne concentrations by a factor of 20, ash collected by the cleanup devices contains lower extractable PAH concentrations than particles collected by the sampling system, and the PAH concentration for particles increased as they approached the stack. (DLS)

2514 **Microsomal lipid peroxidation. II. Stimulation by carbon tetrachloride.** Kornbrust, D.J.; Mavis, R.D. (Univ. of Rochester, NY). *Molecular Pharmacology;* **17**: 408-414(1980).

Carbon tetrachloride initiated lipid peroxidation in isolated rat liver microsomes in the absence of free metal ions. In contrast to the nonenzymatic process stimulated by ferrous iron, CCl_4-induced peroxidation showed an absolute requirement for NADPH and appeared dependent on the integrity of cytochrome. No detectable peroxidation was induced by CCl_4 in microsomes from brain, kidney, or lung, and microsomal aminopyrine demethylase and aniline hydroxylase activities were more than 10-fold lower in these tissues compared to liver. These results are consistent with activation of CCl_4 by cytochrome P-450 to a reactive short lived radical which initiated peroxidation in the immediate vicinity of the cytochrome and thereby initiates peroxidation in the immediate vicinity of the cytochrome and thereby inhibits enzyme activity either by destruction of essential lipids or by direct attack on the enzyme by reactive intermediates of the peroxidative process. Loss of cytochrome P-450 activity then results in cessation of the CCl_4-induced peroxidative response prior to more extensive reaction of membrane polyunsaturated lipids.

2515 **Microsomal lipid peroxidation. I. Characterization of the role of iron and NADPH.** Kornbrust, D.J.; Mavis, R.D. (Univ. of Rochester, NY). *Molecular Pharmacology;* **17**: 400-407(1980).

The NADPH/iron-dependent peroxidation of lipids in rat liver microsomes was found to depend on the presence of free ferrous iron. High concentrations of Fe^{2+} initiated microsomal lipid peroxidation at an initial rate which was independent of NADPH. With Fe^{3+}, lower Fe^{2+} concentrations, or longer incubation times, NADPH stimulated microsomal lipid peroxidation and this stimulation was blocked by cytochrome c. NADPH did not induce peroxidation in the absence of iron, nor did ferric iron in the absence of NADPH. Thus the role of NADPH appears to be maintenance of iron in the reduced Fe^{2+} state. Complete chelation of iron by EDTA completely inhibited peroxidation. Preincubation of microsomes in the absence of iron did not enhance the rate of peroxidation upon subsequent addition of iron, suggesting that iron acts by initiating peroxidative decomposition of membrane lipids rather than by catalyzing the breakdown of preformed hydroperoxides. Ascorbate stimulated iron-induced liposomal peroxidation but had no effect in the absence of iron.

2516 **Simulation of photosynthesis: a resource for energy.** Willner, I.; Ford, W.E.; Otvos, J.W.; Calvin, M. pp 55-81 of Bioelectrochemistry. Keyzer, H.; Gutmann, F. (eds.). New York, NY; Plenum Publishing Corp. (1980).

Artificial devices that mimic the photosynthetic pathway are of interest as a fuel source. A basic concept in the design of such devices is the use of dyes to photosynthesize electron transfer reactions that produce chemical species capable of oxidizing and reducing water. A fundamental limitation accompanying the photodecomposition of water involves back reactions of the intermediary redox species, whereby the potential energy of the photochemical process is degraded. The introduction of interfaces as kinetic barriers to overcome this limitation is discussed.

2517 **Enlarged crystalline patches on the plasma membrane of yeast protoplasts.** Sosinsky, G.; Schekman, R.; Glaeser, R. (Univ. of California, Berkeley). pp 686-687 of 38th annual proceedings of the Electron Microscopy Society of America. Bailey, G.W. (ed.). Ithaca, NY; Electron Microscopy Society of America (1980).

From 38. annual proceedings of the Electron Microscopy Society of America; San Francisco, CA, USA (1980).

The crystalline patches of intramembraneous particles that form in the yeast plasma membrane, under stationary state physiological conditions, represent a potentially interesting specimen for high resolution electron microscopy. Isolation of these crystalline membrane patches first requires removal of the cell wall and the formation of osmotically fragile yeast protoplasts. In developing a procedure for the isolation of these crystalline membrane patches, we have found that the intramembraneous particles form much larger crystalline patches in protoplasts than in intact yeast cells. Researchers performed deep etch experiments and have found that the crystalline array of particles is not expressed on the extracellular surface of the plasma membrane.

2518 **Electron diffraction from DNA crystals.** Downing, K.H. (Univ. of California, Berkeley). pp 536-537 of 38th annual proceedings of the Electron Microscopy Society of America. Bailey, G.W. (ed.). Ithaca, NY; Electron Microscopy Society of America (1980). Contract W-7405-ENG-48.

From 38. annual proceedings of the Electron Microscopy Society of America; San Francisco, CA, USA (1980).

Thin, broad crystals of DNA can be grown by slow precipitation in ethanolic aqueous solution. Crystals of this form are well suited to study by electron diffraction and electron microscopy. In preliminary experiments to test the feasibility of applying electron crystallographic techniques to obtain a direct structure determination of the DNA in these crystals, electron diffraction patterns were obtained from the crystals. These patterns are the first diffraction patterns of any kind to be obtained from single crystals of highly polymerized DNA.

2519 **Solvent viscosity and protein dynamics.** Beece, D.; Eisenstein, L.; Frauenfelder, H.; Good, D.; Marden, M.C.; Reinisch, L.; Reynolds, A.H.; Sorensen, L.B.; Yue, K.T. (Univ. of Illinois, Urbana). *Biochemistry;* **19**: 5147-5157(1980).

Proteins are dynamic systems. Recent evidence demonstrates that they exist in a large number of conformational substates and

can continuously move from one substate to another, motion of a small ligand inside a protein may be possible only through these conformational fluctuations. To test this idea, we study with flash photolysis the binding of CO to protoheme and O_2 and CO to myoglobin in many different solvents. The standard evaluation of such experiments yields information only about the protein-solvent system. A novel approach is presented which permits conclusions concerning the protein. Data from all solvents are considered together, and the rates for transitions of the ligand over various barriers are studied as a function of temperature for fixed solvent viscosities. Results show that over a wide range in viscosity the transition rates in heme-CO are inversely proportional to the solvent viscosity and can consequently be described by the Kramers equation. The rates of O_2 and CO in myoglobin also depend on the solvent viscosity and are most sensitive to the solvent at the lowest viscosity. Viscosity influences protein reactions even in aqueous solutions. The data can be interpreted by a dynamic model in which transitions into and inside myoglobin are governed by fluctuations between conformational substates corresponding to closed and open pathways. Ligand motion thus is mainly controlled by gates and not by state potential barriers. Some charactistic parameters for the substates are determined, and they agree approximately with similar parameters found in Moessbauer experiments. As expected, the barrier parameters evaluated in the novel approach deviate markedly from the ones obtained by the conventional procedure. Comparison with model calculations or basic theories will be meaningful only with the new evaluation, and the method may be essential for many or possibly all biochemical reactions.

5503 Cytology

REFER ALSO TO CITATION(S) 2614, 2615, 2617, 2618, 2620, 2624

2520 **Fine structure of fetal rat calvarium; provisional identification of preosteoclasts.** Rifkin, B.R.; Brand, J.S.; Cushing, J.E.; Coleman, S.J.; Sanavi, F. (Univ. of Rochester, NY). *Calcified Tissue International;* **31**: 21-28(1980).

This is a study of the fine structure of cells of the 20-day fetal rat calvarium. Special attention is given to identifying and characterizing preosteoclasts. These cells are relatively common and located largely, but not exclusively, at the endocranial bone surface. The preosteoclasts are characterized by abundant mitochondria, an incomplete perinuclear Golgi apparatus, and variable-shaped dense granules. The dense granules are unique in appearance in that they contain an internal dense matrix surrounded by a clear halo. Most granules are circular in shape but some are elongate or tubular in form. Granules with identical appearance are observed in osteoclasts. The preosteoclasts are mononucleate, or occasionally binucleate. It is suggested that because preosteoclasts are morphologically distinctive and relatively abundant, it should be feasible to separate these cells from a heterogeneous cell isolate.

5504 Genetics

REFER ALSO TO CITATION(S) 2562, 2570, 2581, 2588, 2601, 2607, 2610, 2611

2521 **Mutants of yeast initiating translation of iso-1-cytochrome c within a region spanning 37 nucleotides.** Sherman, F.; Stewart, J.W.; Schweingruber, A.M. (Univ. of Rochester, NY). *Cell;* **20**: 215-222(May 1980).

A specially constructed strain, cyc1-345, of the yeast Saccharomyces cerevisiae was used to isolate revertants that initiated translation of iso-1-cytochrome c at various sites along an extended region of the mRNA. These results with cyc1-345 revertants indicate that translation of iso-1-cytochrome c can initiate with the normal efficiency at any site within the region spanning 25 nucleotides. Furthermore, because the lower amount of the short iso-1-cytochrome c in the mutant initiating at position 9 may not necessarily reflect an inefficiency of translation, we believe that translation can initiate with normal or near-normal efficiencies at any site witin a 37 nucleotide region. These results establish that there is no absolute requirement for a particular sequence 5′ to the initiation codon, and are consistent with our previous suggestion that translation starts at the AUG codon closest to the 5′ end of the mRNA.

5505 Metabolism

REFER ALSO TO CITATION(S) 2552

2522 (INIS-mf—6528, pp 206-209) **Testing the effect of cytokinin-like regulators on the photosynthesis and protein synthesis with radiometric methods.** Pozsar, B.I.; Szarvas, T.B.; Simon, L.P. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The effects of endogeneous cytokinin (zeatin), synthetic cytokinins (kinetin, benzyladenine), cytokinin-like compounds (6-methyluracil, benzimidazole), and new regulators (Sz-11, Sz-28) with cytokinin-like biological activity on the increase of the mitotic frequency were investigated. The side-effects the above mentioned compounds on the intensity of photosynthetic carbon dioxide fixation, and on protein synthesis were also studied. The regulators showed a high stimulating effect on the anion absorption and an accumulation on the vegetative and generative plant organs.

2523 (INIS-mf—6528, pp 210-212) **Application of isotope tracer method for the metabolism study of a herbicide (EPTC).** Pulay, A.; Horvath, L.; Volford, J. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The metabolism of EPTC (S-ethyl-N,N-dipropylthiocarbamate) was investigated in germinating corn. ^{14}C-labelled (on the carbonyl group) EPTC was used in the studies. Metabolites were separated by thin-layer chromatography. EPTC-sulfone proved to be an active metabolite. It was produced by two-step enzymic oxidation.

5506 Medicine

REFER ALSO TO CITATION(S) 2256, 2276, 2553, 2561

2524 (IA—1356, pp 259-260) **sup(99m)Tc-labelled N-substituted derivatives for hepatobiliary imaging.** Weininger, J.; Trumper, J.; Sadeh, T.; Juszynsky, M. (Israel Atomic Energy Commission, Tel Aviv); Lubin, E. (Beilinson Hospital, Petah Tiqva (Israel). Dept. of Nuclear Medicine). Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2525 (INIS-mf—6528, pp 268-271) **Adsorption chromatographic separation of radioiodine-labelled compounds using binary eluents.** Toth, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

An adsorption chromatographic method using Sephadex LH-20 dextran gel as adsorbent and water-organic solvent binary eluents was developed for the systematic separation of low molecular weight radioiodine-labelled substances like iodothyronines, iodobenzoic acids and iodotyrosine methyl ester derivatives of prostaglandins, steroids etc. The adsorbed iodine compounds were separated by water-organic solvent mixture, and the order of the compounds is in accordance with the increasing number of iodine substituents per molecule. A method is reported which enables the calculation of the eluent strength of the water-organic solvent eluents.

2526 (INIS-mf—6528, pp 272-274) **Importance of technetium-99m labelled metal complexes in the early detection of tumours.** Toerkoe, J. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The early detection of degenerative changes in the organism - mainly tumours - is very important from the point of view of

proper therapy. Among the traditional examinations radioisotopic imaging is a sensitive and wide-spread method. On the basis of the abnormal distribution of radioactivity detected by a suitable equipment it is possible to localize the degenerative changes in the suspected organ. In the paper technetium-99m labelled specific stannous complexes prepared in Institute of Isotopes are discussed. Finally, some typical scintigrams made with the application of these complexes are presented.

2527 (JINR-R—18-12147, pp 299-307) **Short-living nuclides in medicine.** Khalkin, V.A. 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

Discussed is the use of neutron-deficit isotopes of certain elements in research and clinical practice. Among numerous iodine isotopes ^{123}I proves to be ideal for many diagnostic purposes. The radiation dose obtained by the patient from ^{123}I introduced in the patients organism is one hundred times as little as in the case of introduction of the similarly active preparations ^{131}I or ^{125}I. Medico-biological investigations with astate are in progress, particularly to explore the survivability of the cell under the effect of alpha-radiation. Also quite promising is the use of ^{167}Tm to investigate the state of the skeleton and determine the location of tumors in soft tissues. The prospects and method of application of high-energy protons to obtain the said radionuclides are discussed.

2528 (JINR-R—18-12147, pp 193-220) **Application of high-energy heavy charged particles in medicine.** Savchenko, O.V. 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

Beams of heavy charged particles are shown to be endowed with great potentialities for raising the efficiency of radiation therapy and to enable the depth dose distribution to be radically improved. Large-scale clinical tests can be realized on accelerators either already operating or being modernized by setting up medico-biological pavilions with several treatment rooms as adjuncts to them. However, a most complete and effective clinical testing and mass treatment of patients can be implemented solely at specially established multiple-cabin medico-biological complexes with own accelerators.

2529 (JINR-R—18-12147, pp 295-298) **LINF synhrocyclotron proton beam application for radiotherapy.** Konnov, B.A.; Karlin, D.L. ; Nizkovolos, V.B. (Tsentral'nyj Nauchno-Issledovatel'ski Rentgeno-Radiologicheskij Inst., Leningrad (USSR)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

It is shown that accelerators of heavy charged particles intended for fundamental research can be employed for medical purposes. Formation of beams for medico-biological purposes is effected by means of a remote-controlled collimator lying in the main hall of the accelerator at about 50 m distance from the irradiation object and the rotary-focusing electromagnetic elements in the medical proton tract by way of their successive tuning. To raise the ratio of the dose in the radiation source to the surface dose, use is made of two methods simultaneously: focused proton beam and rotational irradiation.

2530 (JINR-R—18-12147, pp 319-326) **Multiwire detectors for biomedical investigations.** Zanevskii, Yu.V. 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

Fields of application and prospects of usage of multiwire proportional chambers (PC) in biophysics, medicine and radiography are presented briefly. High sensitivity of PC to long wave X radiation makes it possible to develop relatively simple devices for X-ray diffractometry. Up to now PC are beyond any competition in that field. Of great interest, as compared with traditional detectors, is the use of PC in the field of neutron radiography. PC also look promising for use in nuclear medicine to detect photons with an energy of up to 100 keV. Due to better spatial resolution and faster response PC have an advantage over detectors based on NaJ crystals. Results obtained in the fields of proton and ion radiography show that the given technique makes it possible to reduce the dose ten times when examining patients as compared with EMI scanners.

2531 (JINR-R—18-12147, pp 327-330) **Using helium ion beam from the JINR synchrotron phase for radiography.** Anisimov, Yu.S.; Govorun, N.N.; Golovatyuk, V.M. . 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

A device intended to carry out radiographic investigations on a beam of helium ions with an energy of 200 MeV per nucleon is described. The device is based on multiwire proportional chambers operating on line with a computer. The device includes scintillation counters, two-coordinate proportional chambers, a module of proportional chambers intended for determining particle stop points (a "stop-point detector"), a set of organic glass high-precision plates used as an absorber, and a box with water intended to eliminate the geometric shape effect. The object under study is located in the box. The "stop-point detector" consists of 12 proportional chambers with a sensitivity area of 280x280 mm located in a single gas volume.

2532 **Microangiography of the bladder in health.** Sarma, K.P. *British Journal of Urology;* **53**: No. 3, 237-240(Jun 1981).

Microangiography of the bladder has been studied by the use of a mixture of Micropaque and Hypaque. There appears to be a considerable variation in the vascular supply, not only in different specimens but also in different parts of the same specimen. In general, the base and the lateral walls are more richly supplied than the rest. The vessels seem to form 3 plexuses: extramural, intramural and submucous. In places, moderately large aberrant vessels spring from the 3 plexuses and proceed into the mucosa itself.

2533 **Detection of left ventricular thrombi by computerised tomography. A preliminary report.** Nair, C.K.; Sketch, M.H.; Mahoney, P.D.; Lynch, J.D.; Mooss, A.N.; Kenney, N.P. (Creighton Univ., Omaha, NE (USA). School of Medicine). *British Heart Journal;* **45**: No. 5, 535-541(May 1981).

Sixteen patients suspected of having left ventricular mural thrombi were studied. All had suffered transmural myocardial infarction. Fifteen patients had a ventricular aneurysm. One had had systemic emboli. The mean length of time between the myocardial infarction and the study was 14.8 months, with a range of one month to 79 months. All patients underwent computerised tomography of the heart, M-mode echocardiography (M-mode), and two-dimensional echocardiography (2-D). Eight patients underwent left ventricular cineangiography. Five patients had surgical confirmation. Computerised tomography, two-dimensional, and M-mode echocardiography predicted left ventricular mural thrombi in 10, eight, and one of the 16 patients, respectively. Left ventricular cineangiography predicted left ventricular mural thrombi in four out of eight patients. Computerised tomography and left ventricular cineangiography correctly predicted the presence or absence of left ventricular thrombi in all five patients who underwent operation. In the same group, however, two-dimensional and M-mode echocardiography failed to predict the presence of thrombi in one and three patients, respectively. Among the 11 patients without surgical confirmation, one, in whom no left ventricular thrombi were shown by M-mode and two-dimensional echocardiography, was found to have thrombi on computerised tomography. In another, two-dimensional echocardiography was positive but this finding was not confirmed either by computerised tomography or by left ventricular angiography.

2534 **Apparatus and method for reconstructing data.** (to Siemens A.G., Berlin (Germany, F.R.)). British Patent 1,587,641/A/. 8 Apr 1981. 35p.

A method and apparatus is described for constructing a two-dimensional picture of an object slice from linear projections of ra-

diation not absorbed or scattered by the object, using convolution methods of data reconstruction, useful in the fields of medical radiology, microscopy, and non-destructive testing.

2535 **Tomographic scanning apparatus.** (to Siemens A.G., Berlin (Germany, F.R.)). British Patent 1,587,642/A/. 8 Apr 1981. 14p.

Details are given of a tomographic scanning apparatus, with particular reference to a multiplexer slip ring means for receiving output from the detectors and enabling interfeed to the image reconstruction station.

2536 **Tomographic scanning apparatus.** (to Siemens A.G., Berlin (Germany, F.R.)). British Patent 1,587,643/A/. 8 Apr 1981. 15p.

Details are given of a tomographic scanning apparatus, with particular reference to the means of adjusting the apparent gain of the signal processing means for receiving output signals from the detectors, to compensate for drift in the gain characteristics, including means for passing a reference signal.

2537 **Tomographic scanning apparatus.** (to Siemens A.G., Berlin (Germany, F.R.)). British Patent 1,587,644/A/. 8 Apr 1981. 13p.

Details are presented of a tomographic scanning apparatus, its rotational assembly, and the control and circuit elements, with particular reference to the amplifier and multiplexing circuits enabling detector signal calibration.

2538 **Positron annihilation imaging device having movable collimator.** Thompson, C.J. British Patent 2,058,510/A/. 8 Apr 1981. 10p.

This patent application relates to a positron annihilation imaging device comprising two circular arrays of detectors disposed in spaced apart parallel planes and circumferentially offset by half the detector spacing, axially movable annular outer collimator rings, generally disposed in a pair of opposite planes outside the associated planes of the detectors, each collimator being movable toward the opposite collimator. An inner collimator of annular configuration is disposed between the two rows of detectors and is formed in two rings which may be separated axially. The outer and inner collimators serve to enhance data readout and imaging.

2539 **Positron annihilation imaging device using multiple offset rings of detectors.** Thompson, C.J. British Patent 2,058,511/A/. 8 Apr 1981. 6p.

This patent application relates to a positron annihilation imaging device comprising two or more coaxial circular arrays of detectors (2,2'), with the detectors in one array angularly offset with respect to the detectors in the adjacent array to detect more than one tomographic image simultaneously through different cross-sections of a patient.

2540 **Improvements in or relating to radiography.** Hounsfield, G.N. (to EMI Ltd., Hayes (UK)). British Patent 1,582,833/A/. 14 Jan 1981. 8p.

A novel form of computerised axial tomography scanner is described in detail. The objective for the device is to obtain accurate information about a selected region of the body without subjecting the patient's skin to unacceptably high radiation dosage. This is achieved using a CAT scanner which, in addition to the usual axial rotation, can tilt up to angles of 25°, thus ensuring that the radiation enters the body through different areas of skin during different revolutions. Explicit details of how this is accomplished and of the data collection procedure are presented.

2541 **Computerized tomography.** (to Philips Medical Systems, Inc., Shelton, CT (USA)). British Patent 1,571,489/A/. 16 Jul 1980. 20p.

Improvements in the design of computerized tomographic X-ray equipment are described which lead to improvements in the mechanical properties, speed and size of scanning areas. The method envisages the body being scanned as a two-dimensional matrix of elements arising from a plurality of concentric rings. The procedures for rotation of the X-ray beam and detectors around the patient and for translating the measured information into attenuation coefficients for each matrix element of the body are described in detail. Explicit derivations are given for the mathematical formulae used.

2542 **Computerized tomography.** (to Philips Medical Systems, Inc., Shelton, CT (USA)). British Patent 1,571,490/A/. 16 Jul 1980. 20p.

Improvements in the design of computerized tomographic X-ray equipment are described which lead to improvements in the mechanical properties, speed and size of scanning areas. The method envisages the body being scanned as a two-dimensional matrix of elements arising from a plurality of concentric rings. The concentric centre need not coincide with the axis of rotation. The procedures for rotation of the X-ray beam and detectors around the patient and for translating the measured information into attenuation coefficients for each matrix element of the body are described in detail. Explicit derivations are given for the mathematical formulae used.

2543 **Radioaktive isotope in klinik und forschung. Bd. 14. (Radioactive isotopes in clinic and research. Volume 14).** Hoefer, R.; Bergmann, H. Vienna, Austria; H. Egermann (1980). vp. (CONF-800149—(Pt.1)).

From 14. international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (9 Jan 1980).

Individual papers are included in the data base. (PSB)

2544 **Radioaktive isotope in klinik und forschung. Bd. 14. (Radioactive isotopes in clinic and research. Volume 14).** Hoefer, R.; Bergmann, H. Vienna, Austria; H. Egermann (1980). vp. (CONF-800149—(Pt.2)).

From 14. international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (9 Jan 1980).

Individual papers are included in the data base. (PSB)

5507 Microbiology

REFER ALSO TO CITATION(S) 2490, 2506, 2507, 2517, 2566, 2600

5508 Morphology

2545 **Appraising the centrality of vertices in trees.** Slater, P.J. *Studia Scientiarum Mathematicarum Hungarica;* **12**: 229-231(1977). Contract AC04-76DP00789.

Pollak and Adam have asked if there exists a tree in which the center, centroid and end vertex centroid are pairwise disjoint. An affirmative answer is given, and it is shown that these sets can be made non-collinear and arbitrarily far apart in trees.

5509 Pathology

2546 **Absorption-excretion function of liver in patients with block of biliary tract in relation to duration of jaundice.** Davydova, L.I.; Kuznetsova, E.E.; Dotsenko, G.D.; Sumtsov, N.A.; Tsivadze, G.I.; Gerbenko, G.I.; Kudinenko, A.S.; Shcherbakov, Yu.M. (Khar'kovskij Nauchno-Issledovatel'skij Inst. Obshchej i Neotlozhnoj Khirurgii (Ukrainian SSR)). pp 47-49 of Ehksperimental'naya i klinicheskaya radiologiya. Kiev, USSR; Zdorov'ya (1979). (In Russian)

Fifty patients with cholelithiasis and oncologic diseases of the pancreatoduodenal zone without metastases to liver complicated with mechanical jaudice have been examined by means of rose bengal labelled with ^{131}I. Considerable and confidential decreases of indicators of functional liver state with increasing jaundice duration has been revealed.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 2623

5520 Public Health

REFER ALSO TO CITATION(S) 2431, 2463, 2613, 2622

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 1855, 1860

2547 (IA—1356, pp 310-311) **Residence time distribution of citrus juice concentrate in a pasteurization unit.** Lewis, S.; Bar-Sela, Y. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2548 (INIS-mf—6528, pp 1-3) **Use of Cherenkov-radiation for the assay of ^{32}P in plant tissues.** Ambro, I. (Nehezvegyipari Kutato Intezet, Veszprem (Hungary). Radiokemiai Osztaly). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The Cherenkov-radiation produced by the β-emitter ^{32}P extracted from plant tissues was applied to check the translocation of the radioactive fertilizer in maize. The paper deals with the influence of the dry material concentration on the efficiency of the measurement. To calculate the absolute radioactivity (dpm) the channel ratio method was used for the quench correction. The experiments show the range of the dry material concentration in which the method was applicable.

2549 **Energy and water conservation strategies in irrigated agriculture.** Ritschard, R.L.; Tsao, K. (Univ. of California, Berkeley). *Water Resources Bulletin;* **16**: No. 2, 340-347(Apr 1980). Contract W-7405-ENG-48.

Growers in California used several energy and water conservation strategies in response to the drought conditions of 1976 and 1977. The strategies included an increased use of ground water, increased irrigation efficiencies, and shifts in cropping patterns. Drought-related losses to irrigated agriculture were minimized as a result of these modifications. Some future problems may have been created, however, by obtaining the needed water supplies for 1976-77. These problems include the effects of extensive water pumping on ground water reservoirs and ground subsidence. In addition, reduced water application by less frequent irrigation and changes in irrigation methods may affect the total salt balance for future years. Several conservation strategies that have some potential application in California were identified as: maintaining and augmenting surface water supply, increasing power use efficiencies, and improving irrigation efficiencies. Electricity savings associated with water conservation have been estimated as high as 25 percent. Specific near term actions suggested for facilitating conservation included: an expanded irrigation management system, efficient water deliveries, and a continued effort on the part of the individual growers to use resources during periods of normal rainfall as they were used under drought conditions.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 2043, 2469, 2483, 2629

2550 **(CONF-810968—1) What is ALARA.** Auxier, J.A.; Dickson, H.W. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01. Order Number DE81030814.

From Edison Electric Institute's Health Physics Committee meeting; Hartford, CT, USA (10 Sep 1981).

The as-low-as-reasonably-achievable (ALARA) philosophy as it applies to personnel radiation exposure has been with us for a long time. The essential tenets of this philosophy surfaced quite early in the history of the Manhattan Project. Although the terminology has suffered through various translations and the application has seen many organizations and agencies come and go, the principles remain as valid today as ever. It is regretable that some regulatory agencies claim ALARA as their newfound miracle drug and that application according to their prescriptions will result in endless rounds of cyclical improvement in radiation protection practices. Others have taken advantage of the popularity of ALARA and have bastardized the philosophy to mean whatever is expedient for their purposes. In this paper, we review briefly the history of ALARA and what it seemingly means to different interest groups and offer a balanced viewpoint that health physicists should adopt.

2551 (IAEA-TECDOC—228, pp 105-108) **Gonad dose assessment using TLD techniques.** Samsen, L. (Radiation Protection Service, Dept. of Medical Sciences, Bangkok, Thailand). Feb 1980. Dep. NTIS (US Sales Only).

In Environmental monitoring for radiological safety in South-East Asia, the Far East and the Pacific regions. Final summary report on the IAEA's co-ordinated research programme between 1972 and 1978.

In Thailand, in the five recent years the genetic dose for the population originated from 5 or 6 types of X-ray examinations. Investigations were carried out to assess these doses as the main contributor to the population exposure. Data are presented for the gonad doses in function of the type of X-ray examination.

2552 (INIS-mf—6528, pp 251-254) **Study of transport processes in plants by radioabsorption and microradiographic methods.** Varro, T.; Madi, I. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Izotop Lab.); Somogyi, Gy. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

The passive transport processes of $^{22}Na^{+}$, $^{137}Cs^{+}$, $^{45}Ca^{2+}$, $^{65}Zn^{2+}$, $^{59}Fe^{3+}$, $^{32}PO_4^{3-}$ ions and "Saphidon (^{14}C)" plant-protecting agent in plants were studied by radioabsorption method. The parameteres of the passive transport processes of $^{212}Pb^{2+}$, borate and tetraborate ions in plants were measured by quantitative microradiographic methods using photoemulsion and nuclear track detectors. Ion diffusion concentration profiles within the plant were determined at various diffusion times and temperatures. The equation of linear diffusion combined with convection was used to determine the diffusion coefficients characteristic of the transport processes.

2553 (JINR-R—18-12147, pp 271-277) **Preliminary results of physical and radiobiological measurements of parameters of neutron beam from the external target the Laboratory of Nuclear Problems synchrocyclotron.** Dzhelepov, V.P.; Savchenko, O.V.; Cherevatenko, E.P. (Joint Inst. for Nuclear Research, Dubna (USSR)); Fadeeva, T.A.; Shmakova, N.L.; Yarmonenko, S.P. (Akademiya Meditsinskikh Nauk SSSR, Moscow. Onkologicheski Nauchnyj Tsentr). 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

A radiobiological estimate of neutrons with energies of some hundred MeV is given. The measurement results for depth and radial distributions of high-energy neutrons are presented. The low magnitude of oxygen ratio throughout the depth of neutron penetration offers a possibility for raising the efficiency of radiation therapy both separately and in combination with the beams of other particles.

2554 **Cancer risk attributable to radiation exposure: some practical problems.** Bond, V.P. (Brookhaven National Lab., Upton, NY (USA)). *Health Physics;* **40**: No. 1, 108-111(Jan 1981).

It appears that quantitative risk estimation for carcinogenesis will be used more and more in connection with case investigations

or litigation involving individuals with a malignancy and a previous history of exposure to a carcinogen. There is some confusion as to how to handle the relevant probabilities. The problems involved are discussed. It is suggested that since the ICRP and the NCRP have now entered into quantitative risk estimation as applied to radiation protection, it would seem to be appropriate for these organizations to provide advice and guidance on appropriate methods for determining probabilities under different circumstances.

2555 **Effects of PTH on local osteoclast stem cells in embryonic mouse bones.** Burger, E.H.; Thesingh, C.W. (Rijksuniversiteit Leiden (Netherlands)). pp 402 of Hormonal control of calcium metabolism. Proceedings of the 7th international conference on calcium regulating hormones (7th parathyroid conference) held at Estes Park, CO, USA, September 5-9, 1980. Cohn, D.V. (Kansas Univ., Kansas City (USA). Medical Center); Talmage, R.V. (North Carolina Univ., Chapel Hill (USA). School of Medicine); Matthews, J.L. (Baylor Univ., Dallas, TX (USA). Medical Center). Amsterdam, Netherlands; Excerpta Medica (1981).

From International conference on calcium regulating hormones; Estes Park, CO, USA (4 Sep 1980).

2556 **Repair and action spectrum of oxygen-independent lethality of near UV light on Haemophilus influenzae and lack of mutation.** Cabrera-Juarez, E.; Setlow, J.K. (Brookhaven National Lab., Upton, NY (USA). Biology Dept.). *Mutation Research;* **72**: No. 1, 49-55(Aug 1980).

Haemophilus influenzae has been inactivated anaerobically at 313, 334, 365 and 405 nm, and exhibits the greatest sensitivity at 334 nm. The rec1 and uvr1 mutants show the greatest increase in sensitivity over the wild-type at 313 nm, but differences could be seen also at the other wavelengths. Anaerobic irradiation is less effective for killing at all the wavelengths than irradiation under aerobic conditions, but the greatest difference was observed at 365 nm. No induced mutation was seen as a result of anaerobic irradiation at 334 nm, although purified transforming DNA can be mutated at this wavelength.

2557 **Inducible repair system in Haemophilus influenzae unaccompanied by mutation.** Notani, N.K.; Setlow, J.K. (Brookhaven National Lab., NY). *Journal of Bacteriology;* **143**: No. 1, 516-519(Jul 1980).

Weigle reactivation of ultraviolet-irradiated HPlc1 phage was observed after ultraviolet or mitomycin C treatment of Haemophilus influenzae cells. The amount of reactivation was considerably increased when the treated cells were incubated in growth medium before infection. The presence of chloramphenicol during this incubation abolished the reactivation. No mutation of this phage accompanied the reactivation. When cells were treated so as to produce a maximal reactivation of phage, neither reactivation nor mutation of cells was observed. It is concluded that H. influenzae has an inducible repair system that is not accompanied by mutation.

2558 **Hazards of radon daughters to the general public.** Myers, D.K.; Johnson, J.R.; Marko, A.M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). pp 813-816 of Radiation protection. A systematic approach to safety. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

The risk estimates of lung cancer resulting from the inhalation by the general public of radon daughters which accumulate inside buildings are discussed. The cost-benefit relationship for decreasing radon daughter exposures in Canadian homes by increasing ventilation rates is also quantified. The main components in this relationship are identified together with the uncertainties associated with some of these components. The uncertainties in the calculated values appeared to be related primarily to the most appropriate risk estimates for inhalation of radon daughters and to actual radon daughter concentrations inside buildings at various ventilation rates.

2559 **DNA excision repair in human cells treated with ultraviolet radiation and 7,12-dimethylbenz[a]anthracene 5,6-oxide.** Ahmed, F.E.; Gentil, A.; Renstein, B.S.; Setlow, R.B. (Brookhaven National Lab., Upton, NY). *Biochimica et Biophysica Acta;* **608**: 154-166(1980).

Excision repair was measured in normal human and xeroderma pigmentosum group C cells treated with 7,12-dimethylbenz[a]anthracene 5,6-oxide and with ultraviolet radiation by the techniques of unscheduled DNA synthesis, repair replication, a modification and bromodeoxyuridine photolysis and endonuclease-sensitive sites assay. Radiautography and repair replication showed that in normal cells the magnitude of repair after a saturation dose of the epoxide to be 0.1 to 0.2, that after a saturating ultraviolet dose, though survival data showed that both doses gave nearly similar killings. Repair was of the long-patch type and repair kinetics after the epoxide treatment were similar to ultraviolet. After a combined treatment with both agents, unscheduled synthesis in normal cells was more than additive. The data indicate that there are different rate-limiting steps in the removal of the ultraviolet and the epoxide damages, and that the residual repair activity in xeroderma pigmentosum cells is accomplished by different, not just fewer, enzymes than in normal cells.

2560 **Experience gained in the use of personal sampling devices.** Tamas, M.C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). pp 389-397 of Advances in radiation protection monitoring. Proceedings of an international symposium held by the IAEA in Stockholm, Sweden, 26-30 June 1978. Vienna, Austria; IAEA (1979). (In French)

After defining the objectives of atmospheric contamination monitoring the author describes the methods employed at the Fontenay-aux-Roses Nuclear Research Centre in facilities where ^{238}Pu and various transplutonium elements are handled. Experience gained from several years' use of personal sampling devices is analysed and the present role of such devices examined. In particular, it would appear that although personal samplers, contrary to general expectation, provide only marginal assistance in estimating the individual exposure of personnel, they do play a very important role in the surveillance of personnel and working areas by indicating abnormal situations.

2561 **Possibilities of efficiency increase of mammary gland cancer treatment.** Aleksandrov, N.N.; Pantyushenko, T.A.; Muravskaya, G.V.; Fradkin, S.Z.; Kozel, T.S.; Rybalova, S.K. pp 167-168 of 3. Vsesoyuznyj s"ezd onkologov. Tezisy dokladov. Tashkent, USSR; Meditsina (1979). (In Russian)

From 3. All-union conference of onkologists; Tashkent, USSR (1978).

2562 (AECL—6958, pp 69-87) **Environmental and genetic interactions in human cancer.** Paterson, M.C. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

Humans, depending upon their genetic make-up, differ in their susceptibility to the cancer-causing effects of extrinsic agents. Clinical and laboratory studies on the hereditary disorder, ataxia telangiectasia (AT) show that persons afflicted with this are cancer-prone and unusually sensitive to conventional radiotherapy. Their skin cells, when cultured, are hypersensitive to killing by ionizing radiation, being defective in the enzymatic repair of radiation-induced damange to the genetic material, deoxyribonucleic acid (DNA). This molecular finding implicates DNA damage and its imperfect repair as an early step in the induction of human cancer by radiation and other carcinogens. The parents of AT patients are clincally normal but their cultured cells are often moderately radiosensitive. The increased radiosensitivity of cultured cells offers a means of identifying a presumed cancer-prone subpopulation that should avoid undue exposure to certain carcinogens. The radioresponse of cells from patients with other cancer-associated genetic disorders and persons suspected of being genetically predisposed to radiation-induced cancer has also been measured. Increased cell killing by γ-rays appears in the complex genetic disease, tuberous

sclerosis. Cells from cancer-stricken members of a leukemia-prone family are also radiosensitive, as are cells from one patient with radiation-associated breast cancer. These radiobiological data, taken together, strongly suggest that genetic factors can interact with extrinsic agents and thereby play a greater causative role in the development of common cancers in man than previously thought.

2563 (AECL—6958, pp 109-114) **ICRP and UNSCEAR: Their roles in defining the most important biomedical effects of ionizing radiation.** Butler, G.C. (National Research Council of Canada, Ottawa, Ontario. Div. of Biological Sciences). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

The history of ICRP from its origin in the British X-ray and Radiation Protection Committee (1921) to the present is described. Particular attention is directed to the evolution of occupational dose limits, which show a gradual decline, and to the perceptions of the most important effects on human beings. Recent developments in derived (or secondary) dose limits are also described. Basic to the dose limits are the risk estimates. UNSCEAR, since its establishment in 1955, has provided leadership in estimating numerically the risks of genetic defects and malignancy from exposure to ionizing radiation. The usefulness of providing risk estimates for public education has severe limitations.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 2463, 2495, 2509, 2510, 2559

2564 **Chemical analysis and biological fate: polynuclear aromatic hydrocarbons.** Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981). 800p. (CONF-8010108—). $59.95.

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

Separate abstracts were prepared for 62 of the 68 papers in this proceedings of the Fifth International Symposium on Chemical Analysis and Biological Fate of Polynuclear Aromatic Hydrocarbons. Those papers not included are duplicates of papers already included in the data base. (KRM)

2565 **Effects of benzo(e)pyrene [B(e)P] and dibenz(a,c)anthracene [DB(a,c)A] on the skin tumor-initiating activity of polycyclic aromatic hydrocarbons.** DiGiovanni, J. (Wistar Inst. of Anatomy and Biology, Philadelphia, PA); Slaga, T.J. pp 17-31 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981). Contract W-7405-ENG-26.

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The present investigation was designed to study the influence of one hydrocarbon on the carcinogenicity of another. Investigations using the two-stage, initiation-promotion system of mouse skin carcinogenesis have aided in understanding the mode of action of one hydrocarbon on the carcinogenicity of another, and is, therefore, used in the present study. The effects of benzo(e)pyrene and dibenz(a,c)anthracene on the tumor-initiating activity of 7 PAH's are analyzed, and the effects of benzo(e)pyrene on the metabolism and DNA-binding of DMBA in mouse skin are determined. (KRM)

2566 **Influence of near ultraviolet irradiation on the mutagenicity of polynuclear aromatic hydrocarbons adsorbed on carbon black.** De Wiest, F.; Gol-Winkler, R. Gielen, J.; Rondia, D. (Univ. of Liege, Belgium). pp 33-41 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

Under the effect of solar ultraviolet light, photoxidation is one of the most important degradation processes for PAH adsorbed to respirable soot particles in the atmosphere. In this paper, the composition, toxicity and biological significance of PAH photoderivatives is described. The first results obtained with the Ames Salmonella test system to estimate the mutagenic properties of some important PAH photoderivatives are discussed. (KRM)

2567 **Metabolic activation of dibenzo[a,i]pyrene and dibenzo[a,h]pyrene.** Hecht, S.S. (American Health Foundation, Valhalla, NY); LaVoie, E.J.; Bedenko, V.; Hoffmann, D.; Sardella, D.J.; Boger, E.; Lehr, R.E. pp 43-54 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This report compares the in vitro metabolism of dibenzo(a,i)pyrene [DB(a,i)P], 2-fluoroDB(a,i)P, 3-fluoroDB(a,i)P, 2,10-difluoroDB(a,i)P and dibenzo(a,h)pyrene [DB(a,h)P], with respect to formation of angular ring dihydrodiols. The low carcinogenicity of angular ring fluorinated derivatives of DB(a,i)P and DB(a,h)P suggested the involvement of these rings in the metabolic activation of DB(a,i)P and DB(a,h)P. The data from these experiments, together with tumorgenicity data on fluorinated compounds, suggest that 3,4-dihydroxyDB(a,i)P and 1,2-dihydro-1,2-dihydroxy-DB-(a,h)P, which can form bay region dihydrodiol epoxides, are proximate carcinogens of DB(a,i)P and DB(a,h)P. (KRM)

2568 **Organ specific activation of carcinogenic polynuclear aromatic hydrocarbons in cell culture.** Langenbach, R. (Environmental Protection Agency, Research Triangle Park, NC); Nesnow, S.; Malick, L. pp 75-84 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This report describes the results when cells from four rat tissues (liver, lung, kidney and bladder) were used to metabolically activate two carcinogenic polynuclear aromatic hydrocarbons [B(a)P and DMBA] and one that is noncarcinogenic (anthracene). The relative mutagenic activities of the hydrocarbons in these cell-mediated systems were then compared with the relative carcinogenicities of the hydrocarbons in the corresponding tissue. Furthermore, the metabolism of B(a)P by the four primary cell types was analyzed by high pressure liquid chromatography, and an attempt was made to correlate the production of certain metabolites with mutagenic activities in the cell-mediated systems. (KRM)

2569 **Kinetics of movement of benzo[a]pyrene into transformable and non-transformable human diploid fibroblasts.** Tejwani, R.; Trewyn, R.W.; Milo, G.E. (Ohio State Univ., Columbus). pp 97-107 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This report presents comparison of the benzopyrene (BP) metabolism in the extracellular medium, cytoplasm and nucleus of transformable and non-transformable human neonatal foreskin (HNF) cells in culture, 24 to 96 hours following initiation of BP treatment. The optimum uptake of (^{3}H)BP into the cytoplasm and localization into the nuclear fractions was observed at 24 and 48 hours after the initiation of treatment. (KRM)

2570 **Mutation induction, metabolism and DNA adduct formation by polycyclic aromatic hydrocarbons in L5178Y mouse lymphoma cells: effects of S-20 concentration.** Thornton, S.C. (Wistar Inst. of Anatomy and Biology, Philadelphia, PA); Diamond, L.; Hite, M.; Baird, W.M. pp 199-208 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The L5178Y mouse lymphoma mutation assay uses rat liver subcellular fractions to activate PAH to mutagenic derivatives, which are then detected by the induction of forward mutations at the thymidine kinase (TK) lows in L5178T cells. In this paper the effect of liver homogenate concentration on hydrocarbon metabo-

lism, DNA adduct formation, and mutation induction in this system are examined. (KRM)

2571 **Differential effect of substrate concentration on metabolic activation: comparison of intact tissues, intact cells and homogenates.** Bigger, C.A.H.; Moschel, R.C.; Dipple, A. (Fredrick Cancer Research Center, MD). pp 209-219 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

For the polycyclic aromatic hydrocarbons, bay region diol-epoxide metabolites, which are responsible for the interaction of the carcinogens with DNA, are formed through three sequential steps. Thus, in liver homogenates the formation of these diol-epoxides might depend on substrate concentration. This paper describes the influence of substrate concentration on the process of hydrocarbon-DNA binding in a variety of biological systems. (KRM)

2572 **Effects of selenium and sulfur on metabolism of benzo[a]pyrene by human pulmonary alveolar macrophages.** Marshall, M.V. (Univ. of Texas System Cancer Center, Houston); McLemore, T.L.; Busbee, D.L.; Martin, R.R.; Griffin, A.C. pp 221-230 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This study examines the effects of selenium (as Na_2SeO_3) and sulfur (as Na_2SO_3) on cytotoxicity and conjugation of benzo(a)pyrene (BaP) by human pulmonary alveolar macrophages (PAM). PAMs obtained from cigarette smokers are less sensitive to trace metal toxicity. Fly ash samples obtained from a coal-fired power plant are less toxic than fly ash from shale oil. The major BaP conjugates produced by human PAMs are sulfate and glutathione conjugates. (KRM)

2573 **Soot and mutation in bacteria and human cells.** Barfknecht, T.R.; Andon, B.M.; Thilly, W.G.; Hites, R.A. (Massachusetts Inst. of Tech., Cambridge). pp 231-242 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper examines various classes of alkylated PAH in terms of their mutagenicity of human lymphoblast cells. These classes of mutagens were methylene chloride extracts of automobile diesel soot. The data show that methylation at the 1 and 2 positions of phenanthrene and the 2 and 9 positions of anthracene results in PAHs that are much more mutagenically potent than the parent compounds in both S. typhimurium and human lymphoblasts. (KRM)

2574 **Microsomal oxidations of methyl-substituted and unsubstituted aromatic hydrocarbons of monomethylbenz[a]anthracenes.** Yang, S.K. (Uniformed Services Univ. of the Health Sciences, Bethesda, MD); Chou, M.W.; Fu, P.P. pp 253-264 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The metabolism of 12 methylbenz(a)anthracenes (MBAs) with rat liver microsomes have been studied to establish whether methyl-substituted double bonds are susceptible to oxidative metabolism; whether a methyl substituent can direct the metabolism away from the methyl-substituted region; whether the relative amounts of trans-3,4-dihydrodiol formed from the metabolism of MBAs can be correlated with the relative carcinogenic activities of the MBAs; and whether a methyl substituent affects the further metabolism of a non-K-region dihydradiol to vicinal dehydrodiol epoxides. The preliminary results indicate that metabolites formed from each MBA are qualitatively similar but quantitatively different. (KRM)

2575 **New results in the detection, identification and mutagenic testing of heterocyclic polycyclic aromatic hydrocarbons.** Karcher, W. (Commission of the EC, JRC, Petten, Netherlands); Nelen, A.; Depaus, R.; van Eijk, J.; Glaude, P.; Jacob, J. pp 317-327 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper investigates the mutagenic and carcinogenic potential of sulfur heterocyclic PAH since many commercial PAH materials derived from coal tar contain sulfur heterocyclics as major impurities. Therefore, this systematic study was initiated to obtain a range of the 3 to 5 ring S-PAH in high purity, to measure and evaluate their spectra, and to test their mutagenic activity. (KRM)

2576 **Polynuclear aromatic hydrocarbon contamination in marine shellfish.** Sirota, G.R.; Uthe, J.F. (Halifax Lab., Nova Scotia). pp 329-341 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper reports some preliminary results of an investigation of PAH residues in American lobsters, soft shell clams and blue mussels from the New Brumswick-Nova Scotia coastal regions. The observed PAH profiles are compared with those of some possible sources of these residues. (KRM)

2577 **HPLC studies of PAH pollution in a Michigan trout stream.** Black, J.J. (Roswell Park Memorial Inst., Buffalo, NY); Hart, T.F. Jr.; Evans, E. pp 343-355 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper presents the results of analytical studies of the distribution of PAH compounds in sediments and biota from the Hersey River in west-central Michigan as determined with high pressure chromatography (HPLC). This area was the former site of a wood preservation facility where wooden poles and railroad ties were treated with creosote from 1902 to 1949. (KRM)

2578 **Dispositon of benzo(a)pyrene in aquatic systems components: periphyton, chironomids, daphnia, fish.** Leversee, G.J. (Savannah River Ecology Lab., Aiken, SC); Giesy, J.P. Jr.; Landrum, P.F.; Bartell, S.; Gerould, S.; Bruno, M.; Spacie, A.; Bowling, J.; Haddock, J.; Fannin, T. pp 357-366 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981). Contract EY-76-A-09-0943.

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper deals with the determination of flux, accumulation, and biotransformation rate constants of ^{14}C-BaP in periphyton, cladocerans, midge larvae, and bluegill sunfish. These organisms were selected because of their importance in energy and materials flow in aquatic systems. Data from these studies are being used to derive parameters for a mechanistic simulation model that predicts PAH flux in lotic systems (Fate of Aromatics Model - FOAM). (KRM)

2579 **In vivo metabolism of naphthalene and benzo[a]pyrene by flatfish.** Varanasi, U.; Gmur, D.J. (National Marine Fisheries Service, Seattle, WA). pp 367-376 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper describes the in vivo metabolism of naphthalene (NPH) and benzo(a)pyrene (BaP) by starry flounder and English sole which were exposed to one or both of these hydrocarbons. These types of benthic fish can accumulate aromatic hydrocarbons

via the food chain and via interstitial water into which a small proportion of these compounds are slowly released. (KRM)

2580 **Hepatic enzymes and tumor histopathology of black bullheads with papillomas.** Tan, B.; Melium, P.; Grizzle, J. (Auburn Univ., AL). pp 377-386 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper describes a biochemical (hepatic enzymes) comparison of black bullheads in two ponds: a polluted sewage treatment pond and a pollution-free nearby pond. A brief summary of the tumor histopathology, and a discussion of the possible route (agent/s) responsible for the high tumor incidence are included. (KRM)

2581 **Cyclopenta[cd]pyrene: metabolism, mutagenicity, and cell transformation.** Nesnow, S. (Environmental Protection Agency, Triangle Park, NC); Moore, M.; Gold, A.; Eisenstadt, E. pp 387-396 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

Cyclopenta(cd)pyrene (CPP), a polycyclic aromatic hydrocarbon without a bay region, is highly mutagenic in the Ames test and tumorigenic on mouse skin. Therefore, investigations of the metabolism, mutagenicity, and cell transformation of CPP were undertaken to gain insight into relationships between molecular structure and biological activity. The results support the hypothesis that CPP is metabolized to CPP-3.4-oxide. (KRM)

2582 **Comparative studies on the tumor initiating activity and metabolism of methylfluorenes and methylbenzofluorenes.** LaVoie, E.J.; Tulley-Freiler, L.; Bedenko, V.; Girach, Z.; Hoffmann, D. (Naylor Dana Inst. for Disease Prevention, Valhalla, NY). pp 417-427 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

In this paper, the molecular basis for the mutagenic activity of 9-alkylfluorenes was explored and the mutagenic potential of several 9-alkyl fluorenes and 9-phenylfluorene was investigated. In addition the major in vitro metabolites of 9-methylfluorene were identified and contrasted with those obtained with fluorene. The tumor initiating activity of fluorene, benzofluorenes, and their methylated derivatives was also evaluated. (KRM)

2583 **Effect of polychlorinated biphenyls on unscheduled DNA synthesis and macromolecular binding of benzo[a]pyrene in cultured human skin fibroblasts.** Safe, S.; Wong, A. (Univ. of Guelph, Ontario). pp 467-474 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbon. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper reports the effects of enzyme induction on B(a)P-mediated unscheduled DNA synthesis and B(a)P metabolism and binding to protein, RNA and DNA using cultured human skin fibroblasts as the host cell and rat hepatic S-9 as the source of metabolic activation. Preliminary data is also presented on the effects of B(a)P on freshly prepared hepatocyte suspensions from minature male Wistar rats pretreated with polychlorinated biphenyls. (KRM)

2584 **Mutagenicity of benzo[a]pyrene metabolites generated on the isolated perfused lung.** Schoeny, R.; Warshawsky, D.; Hund, M.; Nagel. B.; Smiddy, B.A.; Warren, C. (Univ. of Cincinnati, OH). pp 475-485 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper deals with the effects of dose of benzo(a)pyrene (BaP) and/or particulate on the rate and pattern of BaP metabolism in the isolated perfused lungs of rabbits. The BaP metabolite mixtures generated are being evaluated for their mutagenic biological activity using the Salmonella/microsome assay. (KRM)

2585 **Carcinogenicity, mutagenicity and binding studies of the environmental contaminant cyclopenteno[cd]pyrene and some of its derivatives.** Cavalier, E.L. (Univ. of Nebraska Medical Center, Omaha); Rogan, E.G.; Thilly, W.G. pp 487-498 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This study of cyclopenteno(cd)pyrene (CPEP) and the 3,4-dehydro derivative CPAP has focused on the carcinogenicity of these compounds. Both compounds have been tested as complete carcinogens and as tumor initiators, and their activity has been compared to that of the potent carcinogen BP. Binding studies of CPEP, CPAP and BP to mouse skin nucleic acids have been included to provide additional evidence on the nature of the ultimate carcinogenic metabolite of CPEP. The mutagenicity of these compounds and some of their oxidized derivatives has been tested in bacteria. (KRM)

2586 **Human cell neoplastic transformation with benzo[a]pyrene and a bay region reduced analogue of 7,12-dimethylbenz[a]antracene.** Cazer, F.D. (Univ. of Cincinnati, OH); Inbasekaran, M.N.; Loper, J.C.; Tejwani, R.; Witiak, D.T.; Milo, G.E. pp 499-506 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

Since 1,2,3,4-tetrahydro-DMBA (TH-DMBA) was found to be mutagenic in the absence or presence of a microsomal activation system, this paper deals with the oncogenic transformation of human neonatal foreskin fibroblast cells in culture by this A-ring reduced analogue of DMBA. Several indices of human fibroblast cell transformation are studied including morphological changes, growth in soft agar, and growth on chick embryonic skin organ cultures. (KRM)

2587 **Mutagenic activity of polycyclic aromatic hydrocarbon and other environmental pollutants.** Katz, M.; Heddle, J.A.; Salamone, M.F. (York Univ., Toronto, Ontario). pp 519-528 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

In the present study, an improved in vivo micronucleus bone marrow assay has been employed to determine the mutagenicity of 41 polycyclic aromatic hydrocarbons. Furthermore, the effects of the solvents on the toxicity and mutagenicity of chemicals was investigated by a comparison of the responses of five compounds in DMSO and in other solvents, such as saline, 3% gum arabic and corn oil. (KRM)

2588 **Use of bacterial mutagenicity assays to probe steel foundry lung cancer hazard.** Kaiser, C. (McMaster Univ., Hamilton, Ontario); Kerr, A.; McCalla, D.R.; Lockington, J.N.; Gibson, E.S. pp 583-592 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper examines the mutagenicity of extracts obtained from air particulates in the DOFACO steel foundry to examine the levels of mutagenic activity in particulates from areas of the foundry having different apparent risks of lung cancer. The Salmonella/S-9 assay was chosen for this purpose because it is fast and responds well to several chemical losses of organic carcinogens. (KRM)

2589 Fluorescence studies of binding and transport of carcinogenic polynuclear aromatic hydrocarbons across vesicular bilayers. Li, K.P. (Univ. of Lowell, MA). pp 593-602 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The purpose of this report is to establish a fluorimetric method of analysis using ion probes for location of BaP molecules in liposome membranes and further to design experiments for studying BaP and other PAH transport across the bilayers. (KRM)

2590 Transfer of polynuclear aromatic hydrocarbons from particulate matter to membranes measured by fluorescence spectroscopy. Bevan, D.R.; Riemer, S.C.; Lakowicz, J.R. (Univ. of Minnesota, Navarre). pp 603-614 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper describes a method using fluorescence spectroscopy to quantify the rate at which several PAH, namely, dibenzo[a,h]anthracene, benzo[g,h,i]perylene, 3-methylcholanthrene, and dibenzo[c,g]carbazole, are taken up by microsomal membranes and by model bilayer membranes composed of dipalmitoyl-L-α-phosphatidylcholine (DPPC). In addition the relationship between PAH and particulates in the induction of cancer has been studied by examining the effects of particulates on the rates of uptake of these PAH. (KRM)

2591 Strain differences in organ selective DMBA-induced carciongenicity: comparative binding of dimethylbenz[a]anthracene and its 2-fluoro analogue in Sprague-Dawley and Long-Evens rats. Sheikh, Y.M.; Joyce, N.J.; Daniel, F.B.; Oravec, C.T.; Cazer, F.D.; Raber, J.; Mhaskar, D.; Witiak, D.T.; Hart, R.W.; D'Ambrosio, S.M. (Ohio State Univ., Columbus). pp 625-639 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

In order to assess the relationship of initial bending and removal of DNA damage induced by DMBA to organ and strain susceptibility to carcinogens, the binding of DMBA and its 2-fluoro analogue in heart, liver, kidney, lung and mammary gland of female Sprague-Dawley (sensitive) and Long-Evans (resistant) rat strains were studied. These data suggest that the differences observed in the susceptibility to DMBA induced mammary carcinogenesis are related, in part, to the greater ability of such tissues to remove DMBA-induced DN damage. (KRM)

2592 Immunization against polynuclear aromatic hydrocarbon carcinogens. Moolten, F. (Boston Univ. School of Medicine, MA); Schreiber, B.; Rizzone, A.; Weiss, A.; Boger, E. pp 641-653 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper explores the possibility of inducing protective immunity in animals or humans against important chemical carcinogens such as PAH using appropriate immunization procedures. Certain conditions necessary for immune protection against PAH carcinogenesis to be practical are described. These include: (1) a non-carcinogenic analoy of PAH carcinogens should be obtained which would elict antibodies capable of cross-reacting; (2) binding of the antibodies to the carcinogens should neutralize the biological activity of the latter; and (3) immunization should be capable of inducing protective antibodies in sufficient quantity to be protective against PAH exposures that might be expected to occur naturally. (KRM)

2593 Effect of dihydrodiol conformation on the metabolic formation of vicinal dihydrodiol epoxides. Fu, P.P. (National Center for Toxicological Research, Jefferson, AR); Beland, F.A.; Yang, S.K. pp 655-666 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper reports on the metabolism of benzo(a)pyrene(BaP)-Cis-7,8-diol to vicinal diolepoxides and the subsequent binding of these diolepoxides to calf thymus DNA. (KRM)

2594 Stero- and regioselectivity in the enzymatic conjunction of glutahione with (+-)-benzo[a]pyrene 4,5-oxide. Hernadez, O. (National Inst. of Environmental Health Sciences, Research Triangle Park, NC); Foureman, G.L.; Cox, R.H.; Walker, M.; Smith, B.; Bend, J.R. pp 667-674 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The enzymatic conjugation of glutathione (GSH) with epoxides, which is catalyzed by the GSH transferases, is considered a major contributor to the biotransformation and eventual detoxification of these alkylating agents. In this paper, the effects of pH and incubation time on the stereochemistry of the enzymic reaction catalyzed by a purified GSH transferase from little skate liver are examined. A comparative study was initiated with purified rat liver transferases. (KRM)

2595 Tumorigenicity and mutagenicity of 7,12-dimethylbenz[a]anthracene and selected metabolties including the 3,4-dihydrodiols. Wislocki, P.G. (Merck Sharp and Dohme Research Labs., Rahway, NJ); Gadek, K.M.; Juliana, M.M.; MacDonald, J.S.; Chou, M.W.; Yang, S.K.; Lu, A.Y.H. pp 675-685 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper examines the 3,4-diols of DMBA, 7-OHM-12-MBA, 7-M-12-OHMBA and 7,12-diOHMBA for their tumorigenicity in the initiation-promotion tumor model and the 3,4-diols of DMBA and 7-OHM-12-MBA in the newborn mouse tumor model. In addition, a total of 39 derivatives of DMBA were examined for their mutagenicity in strain TA100 using the Ames S. typhimurium/microsome mutagenicity test system. (KRM)

2596 Hematin-dependent monooxygenation of benzo[a]pyrene: positional specificity and DNA-binding in vitro. Omiecinski, C.J. (Univ. of Vermont, Burlington); Juchau, M.R. pp 697-705 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

The present report demonstrates that hematin-dependent mono-oxygenation of BaP is highly positional specific, and results in the formation of an unusual and normally undetected metabolite of BaP. The data also indicate that significant increases in covalently bound DNA-adducts are produced in vitro upon the addition of hematin to these BaP-metabolizing reaction systems. (KRM)

2597 Measurement of polynuclear aromatic hydrocarbons: their derivatives, and their reactivity in diesel automobile exhaust. Gibson, T.L.; Ricci, A.I.; Williams, R.L. (General Motors Research Labs., Warren, MI). pp 707-717 of Chemical analysis and biological fate: polynuclear aromatic hydrocarbons. Cooke, M.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1981).

From 5. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (28 Oct 1980).

This paper focuses on the nitro derivatives of PAH (nitro-PAH) and the contribution that these compounds may make to the

mutagenicity of diesel particulate. The levels of PAH and nitro-PAH in diesel particulate samples were measured, and the effects of nitro-PAH on the observed mutagenicity was determined. The data indicate that the presence of nitro-PAH in diesel exhaust particulate can explain at least part of its mutagenicity in the Ames Salmonella test. Also, the changes observed in PAH and nitro-PAH levels when particulate samples are exposed to filtered exhaust clearly indicate that the PAH in the particulate can react with nitrogen oxides in exhaust to form nitro-PAH. (KRM)

2598 **Polynuclear aromatic hydrocarbons: chemistry and biological effects.** Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980). 1090p. (CONF-791059—). $49.95.

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Separate abstracts were prepared for 60 of the 68 papers included in these proceedings. The other 8 papers have been previously added to the data base. (ERB)

2599 **Metabolism of benzo(a)pyrene in cultured human bronchus, trachea, colon, and esophagus.** Autrup, H.; Jeffrey, A.M.; Harris, C.C. (National Cancer Inst., Bethesda, MD). pp 89-105 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The metabolism of benzo(a)pyrene was studied in cultures of human bronchus, trachea, colon, and esophagus. By using explant culture systems, it was shown that human target tissues can activate benzo(a)pyrene and that the activation pathway is similar to that found in tissues and cell cultures from experimental animal species in which benzo(a)pyrene is a known carcinogen. (JR)

2600 **Influence of epoxide hydratase inhibition on the genetic activity of benzo(a)pyrene in the liver microsome test using mitotic gene conversion in yeasts as a mutagenicity test system.** Bayer, U. (Institut de Recherches Scientifiques sur le Cancer, Villejuif, France); Homola, M.; Siebert, D. pp 153-162 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

An attempt to determine whether the Saccharomyces cerevisiae D4-RD11 yeast strain could be applied to the specific problem of determining the genetic effects of epoxide hydratase inhibition in benzo(a)pyrene exposed cultures was carried out. Further, it was shown the utility of yeast cells as test organisms and the induction of mitotic gene conversion for the detection of genetic effects of chemical compounds in a complex metabolic situation. (JR)

2601 **Effect of antioxidants on the mutagenicity of benzo(a)pyrene and derivatives.** Sullivan, P.D.; Calle, L.M.; Ocasio, I.J.; Kittle, J.D. Jr.; Ellis, L.E. (Ohio Univ., Athens). pp 163-175 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The effects of antioxidants on the mutagenicity of benzo(a)pyrene and some of its substituted derivatives was investigated using the Ames test. Another aspect has been concerned with the study of the effects of substitution on the properties and reactivity of benzo(a)pyrene, therefore, the chemical and enzymatic oxidations of some alkyl-substituted derivatives to free radical products is also discussed. (JR)

2602 **Rat mammary gland versus mouse skin: different mechanisms of activation of aromatic hydrocarbons.** Cavalieri, E. (Univ. of Nebraska Medical Center, Omaha); Sinha, D.; Rogan, E. pp 215-231 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Studies were performed on the mammary gland of rats and the carcinogenic effect of a series of key representative polycyclic aromatic hydrocarbons with different ionization potentials. The carcinogenicity of these hydrocarbons was compared with that of the same compounds in mouse skin. The results obtained are encouraging in terms of possible development of the mammary gland as a target organ in which one-electron oxidation is the selective mechanism of activation of polycyclic aromatic hydrocarbons. (JR)

2603 **Hematin-mediated increases in the monooxygenation of polynuclear aromatic hydrocarbons.** Omiecinski, C.J.; Juchau, M.R. (Univ. of Washington, Seattle). pp 233-242 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Data is presented indicating that the stimulatory effect of hematin on monooxygenase reactions is due to a specific action of hematin on cytochrome P-450. This is based partially on experiments examining the cofactor requirements, substrate specificity, and effects of specific P-450 modifiers. In addition, the monooxygenase systems of extrahepatic tissues may be subject to different regulatory controls than those existing in the liver and that a possible mechanism for the hematin stimulation may be the complexation of heme with pools of free apocytochrome P-450 that exist in these tissues. (JR)

2604 **Inhibition of pulmonary metabolism of benzo(a)pyrene produced by acute tobacco smoke exposure.** Lubawy, W.C.; Isaac, R.S. (Univ. of Kentucky, Lexington). pp 243-257 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Immediate effects of whole smoke or the gas phase from smoke and the delayed effect of tobacco-smoke-condensate administration on the metabolism of benzo(a)pyrene by the isolated perfused rabbit lung was investigated. (JR)

2605 **Comparative metabolism of dihydrodiols of polycyclic aromatic hydrocarbons to bay-region diol epoxides.** Thakker, D.R. (National Institutes of Health, Bethesda, MD); Levin, W.; Yagi, H.; Tada, M.; Conney, A.H.; Jerina, D.M. pp 267-286 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The metabolism of trans dihydrodiols of several polycyclic aromatic hydrocarbons to bay-region diol epoxides is discussed. Comparisons of chemical structures, reactivity, and biological activity are included. (JR)

2606 **Benzo(a)pyrene activation and detoxification by human pulmonary alveolar macrophages and lymphocytes.** Marshall, M.V. (M.D. Anderson Hospital and Tumor Inst., Houston, TX); McLemore, T.L.; Martin, R.R.; Marshall, M.H.; Wray, N.P.; Busbee, D.L.; Cantrell, E.T.; Arnott, M.S.; Griffin, A.C. pp 299-318 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Comparisons of pulmonary alveolar macrophages and circulating lymphocytes from five smokers and five nonsmokers for their ability to metabolize benzo(a)pyrene as determined by high pressure liquid chromatography were carried out. Utilizing this approach, further investigation of activation and detoxification by several human cell types could provide the basis for more precise and comprehensive studies of carcinogen and drug metabolism in the human lung, and for a better assessment of cancer risk in selected populations. (JR)

2607 Metabolic activation of the benzofluoranthenes. Hecht, S.S.; LaVoie, E.; Amin, S.; Bedenko, V.; Hoffmann, D. (American Health Foundation, Valhalla, NY). pp 417-433 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

A study in chemical carcinogenesis is carried out using the benzofluoranthenes. Assays on carcinogenicity when applied to mouse skin were conducted. The binding energy of dibenzo(a,e)fluoranthene to nucleic acids was also investigated. (JR)

2608 Metabolism and subsequent binding of benzo(a)pyrene to DNA in pleuronectid and salmonid fish. Varanasi, U.; Gmur, D.J.; Krahn, M.M. (National Oceanic and Atmospheric Administration, Seattle, WA). pp 455-470 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

A recent study with marine fish showed that liver enzymes from coho salmon and starry flounder extensively metabolized benzo(a)pyrene into reactive intermediates that bind to DNA. The metabolism of benzo(a)pyrene was investigated by high-performance liquid column chromatography. (JR)

2609 Benzo(a)pyrene-DNA adduct formation in cells: time-dependent differences in the benzo(a)pyrene-DNA adducts present. Baird, W.M.; Dumaswala, R.U. (Wistar Inst. of Anatomy and Biology, Philadelphia, PA). pp 471-488 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Procedures involving isolation of the DNA from tritium labelled hydrocarbon-treated cells are discussed. Enzymatic degradation of the DNA to deoxyribonucleosides, and chromatography of the adducts on columns of water gradients were covered as well. (JR)

2610 Oxidative and nonoxidative metabolism of polycyclic aromatic hydrocarbons in rabbit and chicken aortas and in human fetal smooth-muscle cells. Bond, J.A.; Kocan, R.M.; Benditt, E.P.; Juchau, M.R. (Univ. of Washington, Seattle). pp 489-502 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

A description of the various enzyme systems in aortas of rabbits and chickens and in human fetal smooth muscle cells in culture which are responsible overall for the metabolism of F, 12-dimethylbenz(a)anthracene and benzo(a)pyrene-4, 5-oxide are provided. (JR)

2611 Hydrocarbon-deoxyribonucleoside adducts in vivo and in vitro and their relationship to carcinogenicity. Cohen, G.M. (Univ. of Surrey, Guildford, England); Ashurst, S.W.; Selkirk, J.K.; Slaga, T.J. pp 503-521 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980). Contract W-7405-ENG-26.

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

An expansion of the discrepancy between the adducts formed utilizing either microsomes or intact cells appearing to be due primarily to disruption of the relative activities of the oxidative and conjugating enzymes is presented. It is also demonstrated that the qualitative rather than the quantitative nature of the binding of benzo(a)pyrene to mouse skin DNA, which is related to carcinogenicity, is more important. (JR)

2612 Recognition of DNA damage in vitro and in vivo. D'Ambrosio, S.M. (Ohio State Univ., Columbus); Daniel, F.B.; Brash, D. pp 523-541 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Since endonucleases have been used successfully in directly measuring the extent and repair of DNA damage induced by physical and chemical carcinogens in vitro, S-1 and M. luteus endonucleases were used to detect damage induced by DMBA in vitro in Syrian hamster embryo cells, and in vivo in rat mammary gland cells. (DLS)

2613 Mutagenic material in air particles in a steel foundry. Kaiser, C. (McMaster Univ., Hamilton, Ontario); Kerr, A.; McCalla, D.R.; Lockington, J.N.; Gibson, E.S. pp 579-588 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Recently published epidemiological reports indicate lung cancer mortality amongst foundry workers at DOFASCO, Ltd., was higher than found elsewhere in the plant or control populations. Presented are preliminary work on mutagen screening efforts and studies on the use of various sampling devices and on optimization of the assays, followed by data which show a diverse range of mutagenic compounds present in foundry air particulates. (DLS)

2614 Metabolism of 6-, 7-, 8-, and 12-methylbenz(a)anthracenes and hydroxymethylbenz(a)anthracenes. Yang, S.K. (Univ. of the Health Sciences, Bethesda, MD); Chou, M.W.; Fu, P.P. pp 645-662 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Described are the in vitro rat liver microsomal metabolism studies of 6-, 7-, 8-, and 12-MBAs and their hydroxymethylbenz(a)anthracene (OHMBA) derivatives. The potential proximate carcinogenic 3, 4-dihydrodiol metabolites have been found to be formed from each of the hydrocarbons. (DLS)

2615 DNA binding of 7,12-dimethylbenz(a)anthracene (DMBA) and related compounds. Moschel, R.C.; Bigger, C.A.H.; Hudgins, W.R.; Dipple, A. (NCI Frederick Cancer Research Center, MD). pp 663-673 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Although initial reports of the diol-epoxide mechanism for activation of benz(a)anthracene suggested that the key metabolite was an 8, 9-diol 10, 11-oxide, subsequent investigation of the benz(a)anthracene series showed that the important DNA binding and biologically active metabolites were diol epoxides formed in the angular 1, 2, 3, 4-ring. (DLS)

2616 Benzo(e)pyrene dihydrodiols and diol epoxides: chemistry, mutagenicity and tumorigenicity. Lehr, R.E. (Univ. of Oklahoma, Norman); Kumar, S.; Levin, W. pp 675-688 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Tumorigenicity studies of BeP, its dihydrodiols, and other derivatives are reported. The tumorigenicities of BeP, BeP 4, 5-dihydrodiol, BeP 9, 10-dihydrodiol, BeP H_4-9, 10 diol, and 9, 10-H_2BeP have been determined in an initiation-promotion experiment on mouse skin, and the tumorigenicities of BeP, BeP 4, 5-dihydrodiol, and BeP 9, 10-dihydrodiol have been determined in newborn mice. (DLS)

2617 Study of the 7,12-dimethylbenz(a)-anthracene (DMBA) bay region involvement in the production of carcinogen and mutagen metabolites. Sheikh, Y.M. (Ohio State Univ., Columbus); Inbasekaran, M.N.; Daniel, F.B.; Cazer, F.D.; Hart, R.W.; Witiak, D.T. pp 689-731 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Inhibitors of cytochrome P-450 have been employed to determine whether administration of phenobarbital to male Sprague Dawley rats induces DMBA-12-methyl-hydroxyl-and 3,4-dihydrodiol-forming activities that are distinctly different from those responsible for the formation of DMBA-trans-5,6-dihydrodiol, DMBA-trans-8,9-dihydrodiol, and DMBA-trans-10,11-dihydrodiol. Various fluoro-analogues were used to determine comparative metabolic profiles and relationships of formation of various dihydrodiols with carcinogenic or mutagenic activity. (DLS)

2618 Metabolism of 7,12-dimethylbenz(a)-anthracene: quantitation of metabolite formations in rat liver microsomes and a reconstituted enzyme system containing highly purified cytochrome P-450 or P-448. Yang, S.K. (Univ. of the Health Sciences, Bethesda, MD); Chou, M.W.; Wislocki, P.G.; Lu, A.Y.H. pp 733-752 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Summarized are recent findings on the identification of 37 compounds as DMBA metabolites and the quantitative aspects of in vitro DMBA metabolism in rat liver microsomes and in a reconstituted enzyme system containing highly purified cytochrome P-450 or P-448. Results reveal that all methyl groups and unsubstituted ring carbons of DMBA and its hydroxy-methy derivatives are involved in metabolic oxygenations. (DLS)

2619 Gas-chromatographic profile-analysis of PAH metabolites from rat liver microsomes and cells in culture. Jacob, J. (Biochemisches Institut fuer Umweltcarcinogene, Ahrensburg, Germany); Grimmer, G.; Schmoldt, A. pp 807-817 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

A gas-liquid chromatography method was used to measure PAH metabolites in rat liver microsomes and cell cultures due to greater resolution of GLC and the combination of mass spectrometry and GLC for verification purposes. (DLS)

2620 Microsomal uptake of benzo(a)pyrene: effect of adsorption to asbestos, hematite, silica, and carbon black. Lakowicz, J.R.; Bevan, D.R. (Univ. of Minnesota, Navarre). pp 879-898 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Described is a fluorescence spectroscopic method to quantify the rate of BaP uptake in microsomes. This method could be used in bacterial mutagenesis tests and in the characterization of particle-PAH preparations used for carcinogenesis testing in animals. (DLS)

2621 Correlations of mutagenic activity with polynuclear aromatic hydrocarbon content of various mineral oils. Hermann, M. (Institut Francais du Petrole, Rueil-Malmaison, France); Durand, J.P.; Charpentier, J.M.; Chaude, O.; Hofnung, M.; Petroff, N.; Vandecasteele, J.P.; Weill, N. pp 899-916 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The Ames test has been applied for the determination of the mutagenicity of mineral oils of various origins. High-pressure liquid chromatography was used for separation and analysis of the PAH content of these oils. (DLS)

2622 High aryl hydrocarbon hydroxylase inducibility is positively correlated with occurrence of lung cancer. Busbee, D. (North Texas State Univ., Denton); McLemore, T.; Martin, R.R.; Wray, N.; Marshall, M.; Cantrell, E. pp 917-934 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Data presented provide evidence that two separate populations of lung cancer patients contain a greater number of persons who are highly inducible for AHH than do their respective non-cancer control groups. Attempts to determine a correlation between lung cancer occurrence and increased AHH levels have been made. (DLS)

2623 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)-induced alterations in oxidative and nonoxidative biotransformation of PAH in mouse skin: role in anticarcinogenesis by TCDD. DiGiovanni, J. (Univ. of Wisconsin, Madison); Kishore, G.S.; Slaga, T.J.; Boutwell, R.K. pp 935-954 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980). Contract W-7405-ENG-26.

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The inhibitory effect of TCDD on tumor initiation by various PAH has been analyzed by using a two-stage system of mouse-skin tumorigenesis. Biochemical changes are directly correlated with changes in tumor response. (DLS)

2624 Membrane changes associated with aqueous extracts of fossil-fuel generated respirable particulates. Facklam, T.J.; Crowley, J.P.; Drum, M.A.; Dennis, A.J. (Battelle Columbus Labs., OH). pp 955-972 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Membrane proteins of cultured fibroblasts were examined during and after exposure to subtoxic doses of H_2O extracts of fly-ash samples from fossil-fuel-generated power plants. After treatment with various extracts, the cell membrane proteins were labelled with ^{125}I and separated by polyacrylamide electrophoresis. (DLS)

2625 Polynuclear aromatic hydrocarbons and the mutagenicity of used crankcase oils. Peake, E.; Parker, K. (Univ. of Calgary, Alberta). pp 1025-1039 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

In determining the rate of degradation of PAH in spilled crankcase oils and their environmental effects, motor oil samples were analyzed for PAH by combined gas chromatography-mass spectrometry and examined for mutagenic activity by the Ames test. (DLS)

2626 Mutagenicity, tumor initiating activity, and metabolism of tricyclic polynuclear aromatic hydrocarbons. LaVoie, E.; Tulley, L.; Bedenko, V.; Hoffmann, D. (American Health Foundation, Valhalla, NY). pp 1041-1057 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

The positioned isomers of methylfluorene, methylphenanthrene, and methylanthracene were assayed for mutagenic activity. Discussed are the effects of positional isomers of methylated tricy-

clic PAH on their metabolic activation to mutagens and the potential of mutagenic activity to suggest the carcinogenic activity of tricyclic PAH. (DLS)

2627 **Mixed function oxidase inducibility and polyaromatic hydrocarbon metabolism in the mullet, sea catfish, and gulf killifish.** Melius, P. (Auburn Univ., AL); Elam, D.; Kilgore, M.; Tan, B.; Schoor, W.P. pp 1059-1075 of Polynuclear aromatic hydrocarbons: chemistry and biological effects. Bjoerseth, A.; Dennis, A.J. (eds.). Columbus, OH; Battelle Press (1980).

From 4. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (2 Oct 1979).

Studies show that the mullet, sea catfish, and gulf killifish possess MFO systems which are inducible by Aroclor 1254 and by 3-MC. BaP treated gulf killifish did not appear to metabolize BaP as efficiently and seemed to produce lower levels of BaP metabolites than did 3-MC-treated gulf killifish. (DLS)

2628 **Mutation assay in diploid human lymphoblasts: methodological aspects.** Thilly, W.G.; DeLuca, J.G.; Hoppe, H. IV; Liber, H.L.; Penman, B.W. (Massachusetts Inst. of Tech., Cambridge). *Journal of Environmental Pathology and Toxicology;* **1**: 91-99(1977).

The protocol for a recently developed quantitative assay for mutation at the hgprt locus of human lymphoblasts is presented. Practical problems affecting ease of performance and reliability are discussed with the aim of making the assay available for assessment and possible use in other laboratories.

2629 (AECL—6958, pp 89-106) **Environmental genotoxicants. What numbers do we collect.** Sawicki, E. (Environmental Protection Agency, Research Triangle Park, NC (USA)). [nd]. Dep. NTIS (US Sales Only).

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

Various classifications are pesented for the various types of genotoxicants. It is suggested that present methods for analyzing and bioassaying the environmental genotoxicants are unsatisfactory. Suggestions are made to improve this situation. Six genotoxic superexperiments involving human beings are discussed. The chemical, radiation and genetic backgrounds of other high risk groups have been described from the viewpoint of the collection of meaningful numbers. The formation of a National Environmental Genotoxicant Analytical Research Laboratory is recommended. Routine and research multimedia analyses of genotoxicants would be handled by this lab. Reasons are given for the suggestion that this lab should not be under the control of a regulatory agency.

57 Health And Safety

REFER ALSO TO CITATION(S) 2500, 2501

58 GEOSCIENCES

5802 Geophysics

2630 **Pemeability and frictional properties of San Andreas fault gouges.** Chu, C.L.; Wang, C.Y.; Lin, W. (Department of Geology and Geophysics, University of California, Berkeley, California 94720). *Geophysical Research Letters;* **8**: No. 6, 565-568(Jun 1981).

The permeability of a San Andreas fault gouge is determined under confining pressures up to 220 bars; it decreases with pressure from 10 nanodarcy at 15 bars to 0.3 nanodarcy at 220 bars. These values are lower than the values determined by Morrow et al. (1981). Five different samples of fault gouge with significantly different grain-size distributions were sheared between rock joints under confining pressures to determine the effects of grain size and constitution on the strength of the fault gouge. The strength of fault gorge clearly depends on its constitution and grain size distribution, with the coarser sandy fault gouge being stronger than the finer clayey gouge. Furthermore, the coarser gouge tends to strain harden after yielding, leading to greater strength. Thus, on the San Andreas fault, inhomogeneties in gouge materials may cause spatial variations in strength. Using the permeability determined above, we estimate that the excess pore pressure generated in the fault gauge samples during the experimental shear loading may be negligible.

5803 Mineralogy, Petrology, And Rock Mechanics

2631 **HVEM studies of ceramics and minerals.** Heuer, A.H.; Hobbs, L.W.; Mitchell, T.E. (Case Western Reserve Univ., Cleveland, OH). *Electron Microscopy;* **4**: 386-391(1980).

The high-voltage electron microscopy (HVEM) has played an important role in introducing the techniques of transmission electron microscopy to the disciplines of ceramics and mineralogy. HVEM of ceramics and minerals is now used primarily for specialized studies involving advantages other than the high penetrating power of energetic electrons, namely in-situ studies of oxidation and reduction reactions using environmental cells, studies of radiation damage using the high flux capabilities of HVEM's, and statistically-significant studies of dislocation densities in deformed specimens. We review here work representative of the effort on ceramics and minerals being conducted in our groups in the areas of (1) deformation, (2) oxidation and reduction; and (3) radiation damage.

5804 Geochemistry

2632 (JINR-R—18-12147, pp 96-100) **Application of semiconductor Si(Li)-spectrometer with thermoelectric cooling to multi-element analysis; rocks and ores in natural occurrence.** Meier, V.A.; Zhukovski, A.N.; Ponomarev, V.S.; Meier, A.V.; Laptev, I.M.; Sokolov, A.D. (Leningradskii Gosudarstvennyj Univ. (USSR)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

Results of using a developed semiconductor Si(Li) spectrometer with thermoelectric cooling for multielement X-ray radiometric analysis of rocks and ores in natural occurrence are presented. Investigations have been carried out at gold and silver deposits containing Fe, Pb, Zn, and various impurities. Measurements have been taken at points spaced 10 cm apart. At each point the total spectrum has been recorded. It is shown that the X-ray radiometric analysis performed with the help of the described spectrometer makes it possible to obtain a wealth of data about the elemental composition of rocks and ores directly at natural occurrence. The obtained results are more accurate and reliable than those obtained with the use of other radiometric equipment.

2633 **Study of standard rock samples by instrumental neutron activation analysis using high-resolution semiconductor gamma spectrometry.** Bulnaev, A.I.; Vaganov, P.A.; Kyznetsov, R.A.; Pankratov, V.B. pp 232-242 of Prikladnaya yadernaya spektroskopiya. T. 8. Moscow, USSR; Atomizdat (1978). (In Russian)

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

Presented are the results of instumental neutron activation analysis (INAA) of four new Soviet standard magmatic rock samples using high-resolution semiconductor detectors. The investigations were performed to establish the possibilities of the method for determining the microelement content in geological subjects of complex composition, and also to assess the fitness of the above samples as secondary standard samples in the INAA. The samples placed in sealed ampoules were irradiated for 100 hr in a reactor with thermal neutrons, flux density being 7×10^{13} neutron $cm^{-2} s^{-1}$. The γ spectra of activated samples were measured 6-7 days after radiation. The use of the INAA on the basis of high-resolution γ spectrometry was found to permit to determine with high sensitivity and accuracy the content of about thirty microelements in various rocks and other subjects with complex composition. Of all the standard rock samples studied, the KhG-nephelite syenite sample is most suitable as a standard sample for comparison in the INAA, since the microelement content therein corresponds to the optimum content to the highest degree.

5805 Oceanography

2634 **Analysis of current observations on the Georgia shelf.** Kundu, P.K.; Blanton, J.O.; Janopaul, M.M. (Ocean Sciences Center, Nova University, Dania, Florida 33004). *Journal of Physical Oceanography;* **11**: No. 8, 1139-1149(Aug 1981).

An analysis is made of HF radar measurements of surface currents in shallow water near the Georgia coast, and also of vertical profile measurements of current and density. The dominant structure is found to be a clockwise ellipse of semidiurnal periodicity, the ellipses becoming smaller, narrower and turning clockwise with depth. There is a definite phase lead of the bottom currents with respect to the upper currents, and some evidence of veering of the currents in the non-Ekman sense. In order to explain the observed vertical variations, a simple analytical expression is developed for periodic rotary currents in a barotropic ocean of constant eddy viscosity and depth h, when the free-surface elliptic motion is known. The solution depends on the ratios ω/f and h/h/sub Ekman/, and also on the sense of turning of the free surface ellipse. The model is able to explain several features of the observed vertical variations as frictional effects.

64 PHYSICS RESEARCH

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 2709, 2730, 2765, 2806, 2925, 3025

2635 (INIS-mf—6542, pp vp) **Higher order fluid equations for multi-component non-equilibrium stellar (plasma: atmospheres and star clusters.** Cuperman, S.; Weiss, I. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Dryer, M. (Space Environment Laboratory, ERL, NOAA, Boulder, Colorado, U.S.A.). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2636 (INIS-mf—6542, pp vp) **Ejections of matter and enhanced electromagnetic radiation in the solar atmosphere.** Bar, V. (Tel Aviv Univ. (Israel). School of Education). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2637 (INIS-mf—6542, pp vp) **Generalized Roche potential for misalligned binary systems.** Schiller, N.; Avni, Y. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2638 (INIS-mf—6542, pp vp) **Central star evolution.** Harpaz, A. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2639 (INIS-mf—6542, pp vp) **Physical conditions in an optically thin gas cloud irradiated by γ-rays.** Kovner, I.; Milgrom, M. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2640 **Effect of curvature-squared terms on cosmology.** Macrae, K.I.; Riegert, R.J. (Department of Physics, B-019, University of California, at San Diego, La Jolla, California 92093). *Physical Review [Section] D: Particles and Fields;* **24**: No. 10, 2555-2560(15 Nov 1981).

We consider the effect on Friedmann cosmology of adding all possible algebraic terms quadratic in the curvature tensor to the usual Einstein-Hilbert action for gravitation. Assuming that the vacuum energy density (cosmological constant) is not extraordinarily large in any phase of the evolution of the universe, we find that the cosmological solutions of this more general theory are indistinguishable from standard Friedmann models all the way from the initial singularity to the present.

2641 **Observations of masers in regions of star formation.** Downes, D. (Max-Planck-Institut fuer Radioastronomie, Bonn (Germany, F.R.)); Genzel, R. (Harvard Univ., Cambridge, MA (USA). Center for Astrophysics). pp 565-577 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

The authors review recent progress in observations of masers in regions of star formation. Four regions of special interest are described in more detail: Orion, W51, W49 and W3.

2642 **Absolute positions of OH masers associated with HII regions.** Booth, R.S.; Norris, R.P. (Nuffield Radio Astronomy Labs., Jodrell Bank (UK)). pp 579-580 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

The authors have measured the absolute positions of five OH maser sources associated with HII regions, using the Jodrell Bank phase-compensated radio-linked interferometer. In addition, they have mapped the relative positions of the features in the OH spectra at 1665 MHz for all of the sources and at 1667 MHz for 3 of them (W30H, NGC 7538 and W49).

2643 **Pumping of interstellar OH main line masers: an efficient mechanism.** Lucas, R. (Ecole Normale Superieure, 75 - Paris (France)). pp 581-582 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

Hyperfine components of the far-infrared lines of OH are separated by velocity intervals ranging from about .6 to 8.0 km s^{-1}. The author investigates the effects of overlapping due to systematic motions.

2644 **Λ-doublet population inversion in collisions of OH, OD, CH, CD and NH^+.** Dixon, R.N.; Field, D. (Bristol Univ. (UK)). pp 583-587 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

The results of a new approach to the problem of the collisional step in the pumping cycle for OH and CH masers are reported. Rotationally inelastic collisions of OH and CH with both open- and closed-shell collision partners are considered using an expression derived from scattering theory. It is shown how Λ-doublet population inversion may arise in OH and CH. H-atoms and H_2 may show opposite behaviour with CH, one partner cooling where collisions with the other lead to inversion. Implications for maser action are discussed and reveal excellent qualitative agreement with observation. Λ-doublet population inversion in OD, CD and NH^+ is also considered.

2645 **Collisional inversion of the populations of Λ-doublets in CH and OH: a critical study.** Flower, D.R. (Durham Univ. (UK)). pp 589-590 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

Astronomical studies of the CH and OH masers have been based on the hypotheses of both radiative and collisional pumping. The mechanism of collisional inversion of the ground state Λ-doublets by neutral perturbers was first described by Bertojo et al. (1976) who made a semiquantitative analysis of the collision process, based on calculations of potential energy curves. Consideration of the symmetry and the form of the interaction of CH and OH with the spherically symmetric perturbers para-H_2 and He shows that current knowledge of the interaction potential is insufficient for quantitative results to be obtained.

2646 **Pumping of strong H_2O cosmic masers.** Strelnitskii, V.S. (AN SSSR, Moscow. Astronomicheskij Sovet). pp 591-592 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

The author discusses a collisional model of rotational pumping.

2647 **Time variations of interstellar water masers in HII regions.** White, G.J. (Queen Mary Coll., London (UK). Dept. of Physics); MacDonald, G.H. (Kent Univ., Canterbury (UK)). pp 593-598 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

Previous studies of time variations in water vapour sources associated with HII regions have revealed variability on time-scales of 10^6-10^7s. In an attempt to gather more complete information on the variability of interstellar water masers the authors have monitored 18 sources for the 32-month period September 1974-May 1977.

2648 **Further observations of the H_2O emission from NGC 4945.** Lepine, J.R.D.; Marques dos Santos, P. (Observatorio Nacional, Sao Paulo (Brasil). Centro de Radioastronomia). pp 599-601 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

The authors report the results of new observations of the H_2O maser emission from the galaxy NGC 4945 made in July 1979 with the Itapetinga radio telescope. The H_2O emission that was detected in September 1978 represented an intrinsic intensity about ten times that of W 49, the strongest source in our Galaxy, and raised the question of its nature. The main purpose of the new observations was to obtain a more accurate position for the source and to look for variability.

2649 **Interpretation of high-velocity H_2O masers.** Burdyuzha, V.V. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij). pp 603-609 of Interstellar molecules. Andrew, B.H. (ed.) (National Research Council of Canada, Ottawa, Ontario). Dordrecht, Netherlands; D. Reidel (1980).

From 87. international Astronomical Union symposium on interstellar molecules; Mont Tremblant, Quebec, Canada (6 Aug 1979).

Kinematic and physical models of high-velocity H_2O masers are discussed.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 2866, 2941, 2957, 2983

2650 (INIS-mf—6542, pp vp) **Separation of H_2HO and HHO+HHO yields in H_2^+ collisions.** Nir, D.; Avraham, S. (Technion-Israel Inst. of Tech., Haifa). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2651 (INIS-mf—6542, pp vp) **Relations between cross sections of atomic and molecular processes.** Nir, D. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2652 (INIS-mf—6542, pp vp) **Negative fragments yields in D_2^+ collisions.** Nir, D.; Navon, E.; Rosner, B.; Mann, A. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2653 (INIS-mf—6542, pp vp) **Collisional properties of the H_2, (E,F^{1}Σsub(g)sup(+)) state.** Kligler, D. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics); Bokor, J.; Rhodes, C.K. (Illinois Univ., Chicago (USA). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2654 (INIS-mf—6542, pp vp) **Relaxation time for electron-dislocation scattering.** Bergmann, A.; Kaveh, H.; Wiser, N. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2655 (ITEF—44(1980), pp 21-24) **Nuclear shift of p anti p atom levels in the two-channel approximation.** Mur, V.D. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)); Popov, V.S.; Kudryavtsev, A.E. 1980. (In Russian). Dep. NTIS (US Sales Only).

In Conference on nuclear theory.

2656 **Systematics of Rydberg structure in the spectra of the rare gas dimers between the atomic ^{2}P/sup o//sub 3/2/ and ^{2}P/sup o//sub 1/2/ fine-structure thresholds.** Dehmer, P.M.; Pratt, S.T. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **75**: No. 11, 5265-5270(1 Dec 1981).

The relative photoionization cross sections for the rare gas dimers Ar_2, Kr_2, and Xe_2 were measured in the energy region between the respective atomic ^{2}P/sub 3/2//sup o/ and ^{2}P/sub 1/2//sup o/ fine-structure thresholds at wavelength resolutions of 0.15 A for Ar_2, 0.28 A for Kr_2, and 0.45 A for Xe_2. Discrete autoionization structure was observed for all three systems and has been partially analyzed in terms of Rydberg series converging to the C ^{2}Pi/sub 1/2u/ state of the molecular ions. Vertical binding energies for the individual Rydberg states were estimated based on the assumption that the Rydberg states dissociate to a rare gas atom in an ns'[1/2]$_1$/sup o/ or nd'[3/2]$_1$/sup o/ excited state plus a rare gas atom in the $^1S_0$ ground state. The binding energies thus obtained are in excellent agreement with the corresponding values for the C ^{2}Pi/sub 1/2u/ ionic states obtained from previously reported photoelectron spectra. Some of the molecular structure exhibits Beutler—Fano profiles similar to those observed in the nd'[3/2]$_1$/sup o/ atomic series. This is in contrast to the energy region near the first ionization threshold, where it is extremely difficult to find a simple correlation between the atomic and molecular Rydberg structure.

2657 Improved ab initio effective potentials for Ar, Kr, and Xe with applications to their homonuclear dimers. Christiansen, P.A.; Pitzer, K.S.; Lee, Y.S.; Yates, J.H.; Ermler, W.C.; Winter, N.W. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **75**: No. 11, 5410-5415(1 Dec 1981).

Effective core potentials for the Ar, Kr, and Xe atoms derived from numerical Hartree—Fock and Dirac—Hartree—Fock wave functions are applied in SCF and CI calculations of homonuclear diatomic potential energy curves. Detailed comparisons are made with the all-electron calculations of Wadt for the ground and lowest positive states. Relativistic effects, excluding spin—orbit coupling, are seen to be relatively unimportant. Plots of the potential energy curves and computed spectroscopic constants show excellent agreement with the all-electron results. On the other hand, comparisons with results obtained using effective potentials derived using varients of Phillips—Kleinman procedures show dramatic differences for Xe_2 and Xe_2^+. From SCF calculations on Xe_2 and Xe_2^+ it was found that the explicit inclusion of the spin—orbit operator in the SCF procedure (using ω—ω coupling) results in essentially the same potential curves obtained by adding the spin—orbit correction as a final semiempirical perturbation.

2658 High-current D^- production by charge exchange in sodium. Hooper, E.B. Jr.; Poulsen, P.; Pincosy, P.A. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **52**: No. 12, 7027-7038(Dec 1981).

A beam of D^- ions has been produced at 7—13 keV, with currents up to 2.2 A, using charge exchange in sodium vapor. The beam profile is bi-Gaussian with angular divergence 0.7° x 2.8° and peak current density 15 mA/cm². The characteristics of the beam are in excellent agreement with predictions based on atomic cross sections. The sodium vapor target is formed by a jet directed across the beam. The sodium density drops rapidly in the beamline downstream from the charge exchange region, decreasing three orders of magnitude in 15 cm. Measurement and analysis of the plasma accompanying the beam demonstrate that plasma densities nearly equal to the beam density are obtained 1 m from the charge exchange medium. The plasma produced in the sodium is thus well confined to the charge exchange region and does not propagate along the beam.

2659 Linear-algebraic approach to electron-molecule collisions: General formulation. Collins, L.A.; Schneider, B.I. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **24**: No. 5, 2387-2401(Nov 1981).

We present a linear-algebraic approach to electron-molecule collisions based on an integral equations form with either logarithmic or asymptotic boundary conditions. The introduction of exchange effects does not alter the basic form or order of the linear-algebraic equations for a local potential. In addition to the standard procedure of directly evaluating the exchange integrals by numerical quadrature, we also incorporate exchange effects through a separable-potential approximation. Efficient schemes are developed for reducing the number of points and channels that must be included. The method is applied at the static-exchange level to a number of molecular systems including H_2, N_2, LiH, and CO_2.

2660 Double K-shell-to-K-shell electron transfer in ion-atom collisions. Hall, J.; Richard, P.; Gray, T.J.; Lin, C.D.; Jones, K.; Johnson, B.; Gregory, D. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). *Physical Review* [*Section*] *A: General Physics;* **24**: No. 5, 2416-2419(Nov 1981).

In this paper we present the first study of the role of double K-shell-to-K-shell electron transfer in heavy-ion—atom collisions. Consistent analysis procedures for obtaining total cross sections for both single and double K-shell-to-K-shell electron transfer are outlined based on the charge-state dependence of the total x-ray-production cross sections for K-shell satellite and hypersatellite x rays, respectively. Theoretical calculations for the single and double electron-transfer cross sections based on the two-state atomic expansion model and the independent-electron approximation are presented and are found to be in excellent agreement with experiment.

2661 Charge-exchange excitation and recombination of oxygen in the ISX-B tokamak. Isler, R.C.; Murray, L.E.; Kasai, S.; Dunlap, J.L.; Bates, S.C.; Edmonds, P.H.; Lazarus, E.A.; Ma, C.H.; Murakami, M. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review* [*Section*] *A: General Physics;* **24**: No. 5, 2701-2712(Nov 1981).

Several spectral lines produced by charge transfer of neutral-beam hydrogen atoms with completely ionized oxygen have been detected in the ISX-B tokamak, and have been used to compute the absolute concentrations of O^{8+}. Charge-exchange recombination is found to have a minor effect on the total radiative losses, but enhanced transport during neutral-beam injection appears to raise the oxygen radiation from the interior of the discharges by factors of 3 to 5. This result may reflect an increase of anomalous transport rates that could account for the density "clamping" often observed with injection.

2662 Design of a molecular beam surface scattering apparatus for velocity and angular distribution measurements. Ceyer, S.T.; Siekhaus, W.J.; Somorjai, G.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology;* **19**: No. 3, 726-732(Sep 1981).

A molecular beam surface scattering apparatus designed for the study of corrosion and catalytic surface reactions is described. The apparatus incorporates two molecular or atomic beams aimed at a surface characterized by low energy electron diffraction (LEED) and Auger electron spectroscopy (AES), a rotatable, differentially pumped quadrupole mass spectrometer, and a versatile manipulator. Angular distributions and energy distributions as a function of angle and independent of the surface residence time can be measured. Typical data for the oxidation of deuterium to D_2O on a Pt(111) crystal surface are presented.

2663 CO_2 laser coincidences with ν_3 of SiF_4 near 9.7 μm. McDowell, R.S.; Patterson, C.W.; Nereson, N.G.; Peterson, F.R.; Wells, J.S. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Optics Letters;* **6**: No. 9, 422-424(Sep 1981).

Doppler-limited tunable-diode laser spectra of the stretching fundamental (ν_3) of $^{28}SiF_4$ at 1031 cm^{-1} have been analyzed and the spectroscopic constants determined. Explicit identifications have been made for transitions near CO_2 laser lines between 1023 and 1038 cm^{-1}; 51 such transitions have been observed in sub-Doppler saturation spectra obtained with a CO_2 laser. The closest observed coincidence is $R(53)F_1{}^9$ of $^{28}SiF_4$, at -1.391 MHz from $^{12}C^{16}O_2$ (30). Implications for isotope-enrichment experiments are discussed.

2664 Sideband generation in frequency-modulated continuous-wave light through nonlinear near-resonant propagation in an atomic vapor. Paisner, J.A.; Johnson, M.A.; Morris, J.R.; Hackel, L.A. (Lawrence Livermore Laboratory, L-459, University of California, P.O. Box 5508, Livermore, California 94550). *Optics Letters;* **6**: No. 9, 428-430(Sep 1981).

We have observed sideband generation in the spectrum of frequency-modulated light when the light is transmitted near resonance to the D_1 line n Na vapor. The temporal pulse reshaping that gives rise to the self-phase modulation phenomenon is in good agreement with the predictions of a one-dimensional two-level off-resonant Maxwell—Bloch computer code.

2665 Convoy electrons from solids in coincidence with emergent projectile charge state. Laubert, R. (East Carolina Univ., Greenville, NC (USA)); Huldt, S.; Breinig, M.; Liljeby, L.; Elston, S.; Thoe, R.S.; Sellin, I.A. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). *Journal of Physics B: Atomic and Molecular Physics;* **14**: No. 5, 859-862(14 Mar 1981).

Following the passage of fast ions through thin solid targets, the velocity distribution of forward ejected continuum electrons, centred at a velocity about that of the projectile, is found to be substantially independent of the emergent projectile charge state. The

yield per emergent ion is also found to be independent of emergent ion charge state, arguing critically against a projectile charge-dependent, surface-layer origin for the convoy electrons in question.

2666 **Low energy x-ray diagnostics: 1981.** Attwood, D.T.; Henke, B.L. (eds.). New York, NY; American Institute of Physics (1981). 406p. (CONF-810651—). American Inst. of Physics, Inc., Box 765, Schenectady, NY 12301.

From 1981 topical conference on low-energy X-ray diagnostics; Livermore, CA, USA (8 Jun 1981).

Topics covered include: sub-kilovolt sources of x-ray emission; detectors for sub-kilovolt radiation; atomic scattering coefficients and calculations; reflective and diffractive x-ray imaging; coherence, interference and future possibilities. (GHT)

2667 **Theory of implantation recoil atoms.** Betuganov, M.A.; Digilov, M.U.; Kostikov, V.I.; Kumakhov, M.A. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). *Physica Status Solidi [Sectio] A: Applied Research;* **59**: No. 2, 835-842(16 Jun 1980).

An implantation theory of recoil atoms is considered. As is known, the recoil implantation consists in the introduction of atoms of an evaporated film into a substrate by bombardment of the film by accelerated ions. A number of parameters of this process is calculated in terms of a theory of radiation cascade. At first there is presented a calculation of the cascade function with account of nonelastic losses of ion energy and the scattering anisotropy. Then there are calculated a total number of the recoil atoms reaching the substrate, the film thickness dependence of the number of the recoil atoms, and the profile of the recoil atoms in the substrate on the basis of calculated energy spectrum of the cascade atoms. The results are compared with experimental data.

2668 **Calculation of spatial distribution by a Monte Carlo method of backscattering electron emission.** Vicario, E. (Lyon-1 Univ., 69 - Villeurbanne (France)); Escudie, B. (Institut de Chimie et de Physique Industrielles, 69 - Lyon (France)). *Journal de Microscopie et de Spectroscopie Electroniques;* **5**: No. 3, 357-370(Jun 1980). (In French).

From Symposium on the Monte Carlo simulation techniques of electron trajectories; Paris, France (4 Oct 1979).

Backscattering of 30 keV electrons in aluminium, iron, copper, silver, tungsten and gold is studied by a Monte Carlo method. The experimental determination of backscattering spatial distribution of electron is confirmed and scanning electron microscopy detection is optimized.

2669 **Concurrence between the decay channels of the element of 2S 1/2 level of a mesoatom and a possibility to observe effects of neutral currents.** Grechukhin, D.P.; Soldatov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Yadernaya Fizika;* **31**: No. 4, 1003-1018(1980). (In Russian).

For mesoatoms in the region $6<=Z<=17$, intensities are calculated of the satellite lines, shifted from the line $h/2\pi\nu$sub(0), due to the (2s-1s) meson transition that provides with an information on the weak neutral muon-nucleus interaction, by a quantity deltah/$2\pi\nu$, equal to the energy of dipole transition in the electron shell of the mesoatom. Dependences of the intensities of weakly and strongly shifted groups of the satellites on the shell occupation are elucidated. Probabilities of the conversion E0(2s→1s) and E1(2s→2p) meson transitions are obtained. It is shown that in the region $6<=Z<=11$ the capture of at least one electron into the L shell results in a decrease of the quanta $h/2\pi\nu$ sub(0) yield per a production event of the mesoatom in the '2s1/2> state down to the quantity of approximately 10^{-5}. An empirical method is indicated for a search of such a situation, when the electron capture to the L shell does not yet happen during the time of approximately 10^{-10}. Decay processes are investigated in some detail for the '2s1/2> state of the mesoatom (μNa), which, beside (μNe), may be considered as a suitable system for observation of the neutral current effects, because in these mesoatoms the summary intensity of the nondiscriminated group of weakly shifted satellites for all the shell configurations does not already too exceed the intensity of the informative line $h/2\pi\nu$, while the parity nonconservation effect is not yet small.

2670 **Theory of ion scattering by solids.** Mashkova, E.S.; Molchanov, V.A. pp 185-206 of Rasseyanie ionov srednikh ehnergij poverkhnostyami tverdykh tel. Moscow, USSR; Atomizdat (1980). (In Russian)

The chapter is devoted to the analysis of modern approaches to the theoretical solution of the problem of ion scattering of average energies by solids. Most developed are the asymptotic methods. There are two approaches: in the first approach a collision is considered as a result of a single strong ion interaction with a target atom, in the second approach a scattering process is considered as an essentially multiple process. A model of monodeflection, the Firsov theory of multiple collision, various models of scattering by two atoms, a model of scattering by an isolated atomic chain are discussed.

2671 **Spatial regularities in ion scattering by monocrystals. Ion focusing effect.** Mashkova, E.S.; Molchanov, V.A. pp 166-185 of Rasseyanie ionov srednikh ehnergij poverkhnostyami tverdykh tel. Moscow, USSR; Atomizdat (1980). (In Russian)

Results of investigations of spatial distributions of average energies ions scattered by crystal surfaces are discussed. The forms of energy distributions of scattered ions depending on spatial angles and tartet orientation relative to primary ions beam are followed. The ion focusing effect is described which consists in spatial com.pression of the scattered beam. The problem of ion scattering under the conditions of interlocking (at small angle scattering) is considered and data on experiments with targets amorphizing in the process of ion bombardment are given.

2672 **Measurements of power loadings in four-electrode ion beam extraction systems.** Holmes, A.J.T.; Green, T.S. (UKAEA Culham Lab., Abingdon). pp 163-170 of Low-energy ion beams, 1980. Wilson, I.H.; Stephens, K.G. (eds.). Bristol, England; Institute of Physics (1980).

From International conference on low energy ion beams 2; Bath, UK (14 Apr 1980).

Calorimetric measurements have been made of the power deposited on the tetrode extraction system, plasma source and targets of an intense ion beam at high current densities. The combination of a magnetic multipole (or bucket) source and an optimised tetrode extraction system with 12 mm apertures leads to very low power loadings on the extraction grids and plasma source (in some cases less than 10^{-3} of the beam power). This result suggests that the gas pressure can be much lower than 1 mTorr in the extraction region and indicates that multi-ampere DC ion beam sources are feasible.

2673 **Production of H^- and D^- by backscattering from surfaces.** Schneider, P.J.; Berkner, K.H.; Pyle, R.V.; Stearns, J.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Graham, W.G. (New Univ. of Ulster, Londonderry (UK)). pp 171-176 of Low-energy ion beams, 1980. Wilson, I.H.; Stephens, K.G. (eds.). Bristol, England; Institute of Physics (1980).

From International conference on low energy ion beams 2; Bath, UK (14 Apr 1980).

The results from two separate experiments, carried out at low and intermediate incident energies to measure backscattered H^- and D^- yields from surfaces, are reported. In the low-energy experiment a hot tungsten tube furnace was used to produce a beam of hydrogen atoms to bombard a caesium-covered molybdenum target. In the intermediate energy experiment ionised molecular species of H and D with energies between 0.15 and 4.0 keV/nucleus were used to bombard thick targets of Cs, Rb, K, Na and Li. For each target, the D^- and H^- yields exhibited maxima at incident energies between 300 and 1200 eV/nucleus and always at a lower incident energy for H than for D on a given target. Both the H^- and D^- yields decreased, at any given incident energy, in going from Cs to Li in the order given above. These results are consistent with theoretical treatments.

2674 **Direct-extraction H^- ion source.** Gear, P.E.; Sidlow, R. (Science Research Council, Chilton (UK). Rutherford and Appleton Labs.). pp 284-291 of Low-energy ion beams, 1980. Invited and contributed papers presented at the second international conference on low-energy ion beams held at the University of Bath, 14-17 April 1980. Wilson, I.H.; Stephens, K.G. (eds.). Bristol, England; Institute of Physics (1980).

From International conference on low energy ion beams 2; Bath, UK (14 Apr 1980).

A surface-plasma ion source of the Penning type is being developed at the Rutherford and Appleton Laboratories for use with the pulsed-spallation neutron source currently under construction. The source is required to deliver 40 mA of H^- ions at a duty factor of 21/2% (50 Hz X 500 μs). The source, whilst retaining the basic discharge-chamber geometry of the Dudnikov source described by Allison (IEEE Trans. Nucl. Sci.; NS-24: 1594 (1977)), has been substantially redesigned for ease of manufacture and to permit cooling. The source assembly consists of a cooled discharge chamber, a pulsed gas valve, and an external caesium boiler. A 90° sector magnet is placed immediately after the source and is surrounded by a refrigerated cold box to condense out caesium vapour emitted from the discharge region. Details of the source and current results are presented.

2675 **Studies of field-emission gallium ion sources.** Dixon, A.J.; von Engel, A. (Oxford Univ. (UK). Dept. of Engineering Science). pp 292-296 of Low-energy ion beams, 1980. Invited and contributed papers presented at the second international conference on low-energy ion beams held at the University of Bath, 14-17 April 1980. Wilson, I.H.; Stephens, K.G. (eds.). Bristol, England; Institute of Physics (1980).

From International conference on low energy ion beams 2; Bath, UK (14 Apr 1980).

A comparative study of needle and capillary tube anode types of field-emission gallium ion sources is presented. Operational similarities and differences between the two types, the starting voltage, and the behaviour in the steady state are discussed. The remarkably small beam divergence shown at low current is considered to be due to the rapid decrease of the field and ion flux with the emitting angle with respect to the axis.

2676 **Helium ion reflection from polycrystalline platinum.** Mashkova, E.S.; Molchanov, V.A. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki;* 77: No. 12, 2269-2275(Dec 1979). (In Russian).

In order to check experimentally the approximate theory of multiple scattering, reflection of helium ions with energies of 10 to 35 keV from polycrystal platinum is studied. A dependence of energy distributions of reflected ions on the geometry of the experiment and on the energy of incident ions has been investigated. The decrease from 35 down to 10 keV in energy of incident ions is shown to lead to more than a twofold reduction in the half-width of the dome-shaped part of the distributions. In this case, a relative height of a single peak markedly increases. The relationship has been established between the energy distributions of the entire flux of reflected particles and its ionic component. An experimental dependence of the ionization degree of the reflected flux on the velocity of reflected particles has been obtained. A significant discrepancy between the theory and the experiment has been ascertained.

2677 **Study of secondary ions from a sputter ion source.** Chakraborty, P.; Dey, S.D. (Saha Inst. of Nuclear Physics, Calcutta (India). Mass Spectroscopy and Isotope Separator Lab.). pp 285-287 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay, India; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

Secondary sputtered ions, produced from polycrystalline aluminium under 3-8 keV Zn^+ ion bombardment have been studied by a quadrupole mass spectrometer. The sputtered ions are usually multiply and singly charged, mono- and polyatomic, positive and negative ions characteristic of the target. Al^{++}, Al_2^+, Al_3^+ ions have been detected so far. In the present paper, the study of the intensity of secondary Al^+ ions as a function of the bombarding Zn^+ ion energy for three different values of target current density is reported. The variation is found to be linear for each value of target current density. The diminishing behaviour of secondary positive ion emission yield with the rise of primary ion current density may be due to the gradual reduction in the degree of oxygen coverage on the sample surface under the present experimental condition. The present studies are important in the operation of ion sources whose various components are frequently subjected to energetic ion bombardment giving rise to ions of the component materials.

2678 **Yo-denshi shometsu. (Proceedings of the fifth international conference on positron annihilation).** Hasiguti, R.R.; Fujiwara, K. (eds.). Sendai, Japan; Japan Inst. of Metals (1979). vp. (CONF-790437—(Summ.)).

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

Abstracts of individual items from the conference were prepared separately for the data base.

2679 **Prikladnaya yadernaya spektroskopiya. I. 8. (Applied nuclear spectroscopy. V. 8).** Arifov, P.I.; Il'yasov, A.Z.; Mikhailin, A.V.; Tolpegina, L.S. Moscow, USSR; Atomizdat (1978). vp. (In Russian). (CONF-7703141—(Vol.8)).

From 27. all-union conference on nuclear spectroscopy and nuclear structure; Tashkent, USSR (22 Mar 1977).

Separate abstracts are presented for each of the conference papers included in the data base.

2680 **Optical absorption of $SnCl_2$, $SnBr_2$ and SnI_2 molecules as related to mercury-tin halide arcs.** Drop, P.C.; de Groot, J.J.; Verduin, J.H. (Philips Gloeilampenfabrieken N.V., Eindhoven (Netherlands)). pp 491-492 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

2681 **Transport properties of high-temperature air.** Herrmann, D. (Technische Univ. Muenchen (Germany, F.R.)). pp 495-496 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

2682 **Experimental investigation of the broadening of the free-bound Cl^- continuum radiation threshold in a plasma.** Neiger, M.; Schmitt, J.; Zimmermann, B. (Bochum Univ. (Germany, F.R.). Abt. Elektrotechnik). pp 501-502 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

2683 **Theoretical interpretation of the effect of the plasma microfield on the radiative detachment threshold of Cl^-.** Neiger, M.; Zimmermann, B. (Bochum Univ. (Germany, F.R.). Abt. Elektrotechnik). pp 503-504 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

2684 **Measurement of the He-continuum radiation down to the near vuv.** Thoma, P. (Technische Univ. Muenchen (Germany, F.R.)). pp 507-508 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

2685 **Electron and ion density enhancement in short lived nitrogen afterglow.** Janca, J.; El Kattan, N.M.; Talsky, A. (Universita J.E. Purkyne, Brno (Czechoslovakia)). pp 57 - 58 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers I. Berlin, Germany; Physical Society of the GDR (1977).

From 13. international conference on phenomena in ionized gases; Berlin, German Democratic Republic (12 - 17 Sep 1977).

6404 Fluid Physics

REFER ALSO TO CITATION(S) 2279, 2425

2686 (INIS-mf—6542, pp vp) **Rayleigh-Benard instability in a superfluid solution.** Steinberg, V. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2687 (INIS-mf—6542, pp vp) **Memory effects in the motion of suspended particle in a turbulent fluid.** Gitterman, M. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics); Steinberg, V. (Tel Aviv Univ. (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2688 (INIS-mf—6542, pp vp) **Quenching of phonon-drag resistivity in potassium.** Danino, M.; Kaveh, M.; Wiser, N. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2689 (INIS-mf—6542, pp vp) **Specific heat of a 5% ^{3}He-^{4}He solution under pressure.** Polturak, E.; Rosenbaum, R. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2690 **Structure of the ground state of a fermion fluid.** Schmidt, K.E.; Lee, M.A.; Kalos, M.H.; Chester, G.V. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Physical Review Letters;* **47**: No. 11, 807-810(14 Sep 1981).

Variational many-body wave functions for the ground state of liquid ^{3}He which include triplet and backflow correlations are investigated with use of Monte Carlo integration. Our energy of -1.9°K removes half of the discrepancy between previous Jastrow-Slater calculations and experimental results. The first exact results for mass-three bosons are also presented. Triplet correlations in the variational wave function are equally effective in lowering the energy of both mass-three bosons and ^{3}He.

2691 **Accurate calculations of field-reversed axisymmetric equilibria and their MHD stability properties.** Anderson, D.V.; Barnes, D.C. (Lawrence Livermore National Laboratory, University of California, California 94550). *Journal of Computational Physics;* **41**: No. 1, 288-308(Aug 1981).

Finite elements with bi-cubic, B-spline basis functions are used to represent the flux functions of an axisymmetric, field-reversed plasma. Equilibria, in this representation, are obtained by the collocation method and a generalized ICCG algorithm. For the infinite, toroidal-mode number limit of the MHD energy principle, coupled Sturm—Liouville-like equations result on each flux line. A secant-bisection shooting method employing the gridless Gear integrator is used to find very accurate eigenfunctions, eigenvalues, and growth rates from the continuous-spline representation of the fields. Precise agreement with some exact analytic work is obtained.

2692 **Transient convective transport from a body arbitrary shape.** Morrison, F.A. Jr.; Griffiths, S.K. (University of California, Lawrence Livermore National Laboratory, Livermore Calif. 94550 Mem. ASME). *Journal of Heat Transfer;* **103**: No. 1, 92-95(Feb 1981).

The net rate of transient convective heat transfer from a body at uniform temperature in steady flow is shown to be invariant to pointwise reversal of the flow. Such reversal is physically possible in both creeping and potential flows. Creeping flow and the unseparated potential flow of a low Prandtl number fluid yield physically important transfer problems. Additionally, the theorem is applicable to problems for which flow reversal has no physical significance; numerical reversal of any incompressible streaming flow will leave the net transfer rate unchanged. The proof is not based on symmetry and places no restriction on the shape of the body. It remains valid over the entire range of Reynolds and Peclet numbers even though local transfer rates may differ significantly in the two directions of flow. The theorem applies to the analogous mass transport and is generalized to include a homogeneous first order reaction decreasing the concentration.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 2813

2693 (CERN—81-03, pp 390-406) **Symbolic computation and its application to high energy physics.** Hearn, A.C. (Utah Univ., Salt Lake City (USA). Dept. of Computer Science). 12 Mar 1981. Dep. NTIS (US Sales Only).

From CERN school of computing; Vraona-Attiki, Greece (14 Sep 1980).

It is clear that we are in the middle of an electronic revolution whose effect will be as profound as the industrial revolution. The continuing advances in computing technology will provide us with devices which will make present day computers appear primitive. In this environment, the algebraic and other non-mumerical capabilities of such devices will become increasingly important. These lectures will review the present state of the field of algebraic computation and its potential for problem solving in high energy physics and related areas. We shall begin with a brief description of the available systems and examine the data objects which they consider. As an example of the facilities which these systems can offer, we shall then consider the problem of analytic integration, since this is so fundamental to many of the calculational techniques used by high energy physicists. Finally, we shall study the implications which the current developments in hardware technology hold for scientific problem solving.

2694 **Graphical presentation for data analysis in particle physics experiments: the HBOOK/HPLOT package.** Brun, R.; Palazzi, P. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 93-104 of Eurographics 80. Proceedings of the international conference and exhibition at Geneva, Switzerland, 3-5 September 1980. Vandoni, C.E. (ed.). Amsterdam, Netherlands; North-Holland (1980).

From International conference and exhibition on eurographics; Geneva, Switzerland (3 Sep 1980).

HBOOK is a subroutine package to handle statistical distributions (histograms and scatter plots) in a FORTRAN scientific computation environment. It presents results graphically on the line printer, and can optionally draw them on graphic output devices via the HPLOT subpackage.

6451 Particle Interactions And Properties - Experimental

2695 (KEK—79-1, pp 65-74) **Proposal of the experiment with anti p beam at K2. Polarization measurement of the elastic anti pp and anti pn reaction.** Watase, Y. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). May 1979. Dep. NTIS (US Sales Only).

From Meeting on exotic states in antiprotion-nucleon interactions; Oho, Ibaraki, Japan (21 Dec 1978).

At first, I would like report shortly the progress of construction of the TELAS spectrometer system which is general purpose detector with a polarized target. Secondary, an experimental proposal with a medium energy anti p beam (1 to 2 GeV/c) at K2 beam channel is discussed.

2696 (KEK—79-1, pp 101-105) **Experiments with polarized antiprotons. Experiments on antiproton polarization measurement in antiproton-carbon scattering.** Hamatsu, R. (Tokyo Metropolitan Univ. (Japan). Faculty of Science). May 1979. (In Japanese). Dep. NTIS (US Sales Only).

From Meeting on exotic states in antiprotion-nucleon interactions; Oho, Ibaraki, Japan (21 Dec 1978).

Though there is a model by R.A. Bryan and R.J.N. Phillips (B-P model) as the one describing proton-antiproton two body scattering and total cross section in low energy region, this model satisfies only a part of the experimental results on the films taken with the CERN 80 cm hydrogen bubble chamber, but does not satisfy the remainder. Tokyo group investigated such B-P model, and was able to obtain the result well explaining the experimental results by adjusting the π-N coupling constant. The group has also investigated the possibility on polarized antiproton beam. If the polarized antiproton beam can be realized, the systematic research on baryon-antibaryon system may be advanced through the large variety of experiments in this field by injecting the polarized beam into a bubble chamber. Carbon is a very good polarizer in proton-carbon scattering. If carbon shows the similar polarizing power in antiproton-carbon scattering to that, the polarized anti-proton beam may be realized. Therefore the experiments to measure anti-proton polarization has been examined. Finally, the future prospect for anti-proton-carbon scattering experiments in the National Laboratory for High Energy Physics is described.

2697 (KFTI—79-48, pp 5-7) **Polarization of protons in the $\gamma p \rightarrow \pi^0 p$ at the range of second πN-resonance.** Bratashevskii, A.S.; Derebchinskii, A.I.; Zybalov, A.A.; Konovalov, O.G.; Omelaenko, A.S.; Sorokin, P.V.; Tenishev, A.E.; Tonapetyan, S.G. 1979. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

Proton polarization in the $\gamma p \rightarrow \pi^0 p$ reaction has been measured in the photon energy range 500-800 MeV at the 20 MeV step and the angles of pion emission in the center-of-mass system equal to 100, 120, 140 deg. The energy resolution in the experiment does not exceed +- 10 MeV, statistical accuracy is at the level +-0.1. A preliminary analysis of the Metkaff-Volker type has been carried out on the basis of the data obtained. The sensitivity of the $S_{11}(1530)$ resonance amplitude to new polarization data in the region of the second πN-resonance is found.

2698 **Study of the reaction $\pi p p \rightarrow n\Lambda\Lambda$-bar at 6.0 and 7.0 GeV/c.** Stangl, M.J.; Cason, N.M.; Bishop, J.M.; Biswas, N.N.; Kenney, V.P.; Polychronakos, V.A.; Ruchti, R.C.; Shephard, W.D.; Watson, J.M. (University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review [Section] D: Particles and Fields;* **24**: No. 9, 2347-2352(1 Nov 1981).

The $\Lambda\Lambda$-bar system produced in the reaction $\pi^- p \rightarrow n\Lambda$Lambda-bar at 6.0 and 7.0 GeV/c has been studied utilizing the ANL1.5-m streamer-chamber facility. A 400 000-photograph exposure yielded 284 unweighted nALambda-bar events. The cross section for the reaction is 0.51 +- 0.22 μb at 6.0 GeV/c and 1.21 +- 0.23 μb at 7.0 GeV/c. No significant indications of baryonium states decaying into ΛLambda-bar are found.

2699 **Study of the Okubo-Zweig-Iizuka—rule—violating reactions πin$\rightarrow$phip and $\pi^+ p \rightarrow$phiΔ^{++} at 10 GeV/c.** Hendrickson, J.S.; Denney, D.L.; Gorbics, M.; Anderson, E.W.; Crawley, H.B.; Firestone, A.; Kernan, W.J.; Lamsa, J.W.; Meyer, W.T.; Parker, D.L.; Chapman, J.W.; Seidl, A.A. (Department of Physics and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields;* **24**: No. 9, 2526-2528(1 Nov 1981).

We have measured the cross sections for the Okubo-Zweig-Iizuka—rule—violating reactions $\pi^+ n \rightarrow$phip and $\pi^+ p \rightarrow$phiΔ^{++} at 10 GeV/c using the large-aperture-solenoid spectrometer at the Stanford Linear Accelerator Center. We measure the total cross sections for these two reactions to be 179 +- 72 nb for the phip reaction and 172 +- 75 nb for the phiΔ^{++} reaction. Both of these cross sections are consistent with the hypothesis of the phi being produced solely by its nonstrange-quark component as determined from the octet-singlet mixing angle resulting from application of the Gell-Mann—Okubo mass formula to the vector-meson nonet. These data are thus inconsistent with an ideally mixed phi meson.

2700 **Search for narrow structures in pp-barπi and Λp-bar^{+-} systems.** Chung, S.U.; Etkin, A.; Fernow, R.C.; Foley, K.J.; Goldman, J.H.; Kirk, H.; Kopp, J.; Lesnik, A.; Love, W.A.; Morris, T.W.; Ozaki, S.; Platner, E.D.; Protopopescu, S.D.; Saulys, A.; Weygand, D.P.; Wheeler, C.D.; Willen, E.H.; Winik, M.; Bensinger, J.; Morris, W.; Lindenbaum, S.J.; Kramer, M.A.; Mallik, U.; Bar-Yam, Z.; Dowd, J.; Kern, W.; Button-Shafer, J.; Dhar, S.; Lichti, R. (Brookhaven National Labortory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* **24**: No. 9, 2532-2535(1 Nov 1981).

We have performed a high-statistics search for narrow meson states ($\Gamma <$ or $=$30 MeV) produced in $\pi^- p$ interactions at 16 GeV/c and decaying into pp-barπ^+ or Λp-barπ^{+-}. This is the first systematic search in channels requiring exchange of exotic mesons. The cross section for production of such states is ruled out at the 95% confidence level with upper limits ranging from $\sim$10 nb at 2.3 GeV to $\sim$40 nb at 2.8 GeV.

2701 **Limits on CP-invariance violation of K$^+$/sub mu3/ decays.** Campbell, M.K.; Black, J.K.; Blatt, S.R.; Kasha, H.; Schmidt, M.P.; Adair, R.K.; Morse, W.M.; Leipuner, L.B.; Larsen, R.C. (Department of Physics, Yale University, New Haven, Connecticut 06520). *Physical Review Letters;* **47**: No. 15, 1032-1035(12 Oct 1981).

The CP-nonconserving polarization of μ^+ from K/sub mu3/ decays in the direction (p-bar/sub π/ x p-bar/sub μ/) normal to the plane of decay was measured to be (-3.0 +- 4.7) x 10^{-3} for events such that (p-bar/sub μ/xp-bar/sub ν/) = 0. The value of Imzeta is then -0.016 +- 0.025. This null result places constraints on certain models of CP nonconservation through the exchange of Higgs bosons.

2702 **Isospin dependence of pion absorption on a pair of nucleons.** Ashery, D.; Holt, R.J.; Jackson, H.E.; Schiffer, J.P.; Specht, J.R.; Stephenson, K.E.; McKeown, R.D.; Ungar, J.; Segel, R.E.; Zupranski, P. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **47**: No. 13, 895-898(28 Sep 1981).

The relative ccross sections for the $2N+\pi \rightarrow 2N$ reactions were determined where the initial two nucleons are in a relative s state, and coupled either to isospin zero or to one. This information is extracted from two-nucleon coincidence measurements of the (π^+,2p) and the (π^-,pn) reactions on targets of ^{3}He and ^{4}He.

2703 **Is there an Aharonov-Bohm effect for neutrons?.** Greenberger, D.M.; Atwood, D.K.; Arthur, J.; Shull, C.G.; Schlenker, M. (Department of Physics, The City College of the City University of New York, New York, New York 10031). *Physical Review Letters;* **47**: No. 11, 751-754(14 Sep 1981).

A neutron interferometer experiment testing the existence of an Aharonov-Bohm effect has been performed and no measurable phase shift has been found upon reversal of the enclosed magnetic flux. A positive result would have provided evidence for a breakdown in the standard minimal-coupling scheme for the electromag-

netic interaction of a neutron. The sensitivity of the experiment sets the ratio of the Aharonov-Bohm effect for a neutron to that of a particle of charge e to be less than 5×10^{-13}.

2704 Measurement of inclusive eta production in e^+e^- interactions near charm threshold. Partridge, R.; Peck, C.; Porter, F.C.; Gu, Y.F.; Kollmann, W.; Richardson, M.; Strauch, K.; Wacker, K.; Aschman, D.; Bagger, J.; Burnett, T.; Cavalli-Sforza, M.; Coyne, D.; Joy, M.; Sadrozinski, H.F.W.; Hofstadter, R.; Horisberger, R.; Kirkbride, I.; Kolanoski, H.; Koenigsmann, K.; Liberman, A.; O'Reilly, J.; Osterheld, A.; Tompkins, J.; Bloom, E.; Bulos, F.; Chestnut, R.; Gaiser, J.; Godfrey, G.; Kiesling, C.; Lockman, W.; Oreglia, M. (Physics Department, California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* **47**: No. 11, 760-763(14 Sep 1981).

We have measured the inclusive cross section for eta production in e^+e^- interactions near charm threshold using the Crystal Ball detector. No pronounced structure in the energy dependence is observed. By comparing cross sections above and below charm threshold we obtain the limits (90% confidence limit): R(e^+e^-→FF-barX)Br(F→etax) <0.15—0.32 (for E/sub c.m./ from 4.0 to 4.5 GeV), Br(D→etax)<0.13 [averaged over charged and neutral D components of the psi''(3770) decays]. Our results are inconsistent with a previous report of a large energy dependence of the eta cross section ascribed to the crossing the FF* and F*F* production thresholds.

2705 Measurement of B-meson semileptonic decay. Spencer, L.J.; Finocchiaro, G.; Lee-Franzini, J.; Giannini, G.; Schamberger, R.D. Jr.; Sivertz, M.; Tuts, P.M.; Boehringer, T.; Costantini, F.; Dobbins, J.; Franzini, P.; Han, K.; Herb, S.W.; Lederman, L.M.; Mageras, G.; Peterson, D.; Rice, E.; Yoh, J.K.; Imlay, R.; Levman, G.; Metcalf, W.; Sreedhar, V.; Blanar, G.; Dietl, H.; Eigen, G.; Lorenz, E.; Pauss, F.; Vogel, H. (The State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review Letters;* **47**: No. 11, 771-774(14 Sep 1981).

Using the Columbia University-Stony Brook detector we have measured the production of energetic electrons (E>1 GeV) in e^+e^- annihilations in the center-of-mass energy range 10.4 to 11.4 GeV. We observe an enhanced electron signal at the Y''''(4S) resonance, which we interpret as evidence for the β decay of a new flavor of quark, b, bound within a new flavor meson, B. We derive a branching ratio for B→Xeν of (13.6 +- 2.5 +- 3)%. The observed energy spectrum of the electrons favors the decay b→ceν over b→ueν.

2706 One-pion production in antiproton-proton interactions at 8.8 GeV/c. Simmons, A.J.; Ansorge, R.E.; Booth, C.N.; Carter, J.R.; Neale, W.W.; Rushbrooke, J.G.; Ward, D.R.; White, T.O. (Cambridge Univ. (UK). Cavendish Lab.); Lewis, R.A.; Oh, B.Y. (Michigan State Univ., East Lansing (USA). Dept. of Physics). *Nuclear Physics [Section] B;* **172**: No. 2/3, 285-301(Sep 1980).

We present a study of the reactions anti pp → anti ppπ^0, anti pp → anti pnπ^+, and anti pp → anti npπ^- at 8.8 GeV/c. Cross sections for the reactions are given, and the main features of the data are shown, The data are compared with the predictions of the Deck model, and evidence is presented for the presence of baryon exchange in the Deck amplitude.

2707 Exclusive annihilation processes in 8.8 GeV anti pp interactions and comparisons between anti pp non-annihilations and pp interactions. Ward, D.R.; Simmons, A.J.; Ansorge, R.E.; Booth, C.N.; Carter, J.R.; Neale, W.W.; Rushbrooke, J.G.; White, T.O. (Cambridge Univ. (UK). Cavendish Lab.); Lewis, R.A.; Oh, B.Y. (Michigan State Univ., East Lansing (USA). Dept. of Physics). *Nuclear Physics [Section] B;* **172**: No. 2/3, 302-326(Sep 1980).

We give cross sections for annihilation and non-annihilation reactions in anti pp interactions at 8.8 GeV. The non-annihilation data are compared with pp data from the same experiment. We compare data on resonance production and on the impact parameter structure of the final states in anti pp annihilation and non-annihilation and pp interactions. We investigate the charge structure of the $2\pi^+2\pi^-\pi^0$ final state, and find it consistent with a simple quark model.

2708 High mass meson resonance production in pp interactions at 405 GeV/c. Suzuki, A.; Fukawa, M.; Kabe, S.; Kichimi, H.; Ochiai, F.; Sato, T.; Sugahara, R.; Yoshimura, Y.; Takahaschi, K. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)); Okusawa, T. (Osaka City Univ. (Japan)). *Nuclear Physics [Section] B;* **172**: No. 2/3, 327-334(Sep 1980).

We have observed high mass resonances with mass above 1.5 GeV in pp interactions at 405 GeV/c. We obtain cross sections 13.2 +- 2.9, 5.1 +- 1.5 and 0.27 +- 0.18 mb for rho^0, f, g^0, and h meson production, respectively. The invariant x and p^{2}sub(T) distributions for produced resonances are analysed. A relative comparison of the average <psub(T)> distribution as a function of resonance masses with that for $\mu^+\mu^-$ pair production shows remarkable similarity.

2709 Astrophysical constraints on the mass of heavy stable neutral leptons. Zel'dovich, Ya.B.; Klypin, A.A.; Khlopov, M.Yu.; Chechetkin, V.M. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). *Yadernaya Fizika;* **31**: No. 5, 1286-1294(1980). (In Russian).

It is shown that heavy neutral stable leptons are taken away by the collapsing matter in the process of formation of galaxies and, possibly, of stars. Motion of leptons in a nonstationary field of the collapsing matter ensures the effective mechanism of the lepton energy dissipation. Condensation in galaxies and stars induces a noticable annihilation of leptons and antileptons. Contemporary observations of the cosmic rays and γ radiation impose an upper bound on the mass of the neutral leptons msub(ν) > or approximately 100 GeV, since annihilation of neutral leptons yields the γ radiation and cosmic rays. The obtained restriction along with the ones established previously gives a zero probability for existence of stable neutral leptons (neutrino) with msub(ν) > 30 eV.

2710 Hadron production at transverse momenta from 0.5 to 2.2 GeV/c in proton-proton collisions at 70 GeV. Abramov, V.V.; Alekseev, A.V.; Baldin, B.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). *Yadernaya Fizika;* **31**: No. 4, 937-946(1980). (In Russian).

Measured are cross sections of πsup(+-), Ksup(+-), p and anti p production in pp-collisions at 70 GeV in the range of transverse momenta 0.48-2.21 GeV/c and the angle Qsub(scm)=90 deg. The calculations are carried out on a focusing two-arm spectrometer, the device equipment is on-line system. Accounting on spectrometer acceptance, absorption, decay and particle ionization losses is calculated by the Monte-Karlo method. Determined and graphically and in tables presented are invariant cross section of the observed particle production and yield relation of PI^+/PI^-, K^+/K^-, K^+/PI^+, K^-/PI^-, anti p/PI^- particles in pp-collisions at different values of transverse momenta. The experimental data are compared with the results, obtained at higher or lower proton energy as well as with calculations by quantum-chromodynamic parton model, which describes the experimental results qualitatively correctly. The best agreement is obtained for PI^+/PI^- and K^+/PI^+ yield relations.

2711 Inclusive production of slow protons and Δii(1236) isobars in π^+p interactions at 32 GeV/c. Azhinenko, I.V.; Belokopytov, Yu.A.; Vorob'ev, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). *Yadernaya Fizika;* **31**: No. 4, 956-966(1980). (In Russian).

Investigated is inclusive production of slow protons and Δ^{++}(1236) in PI^+p-interactions at 32 GeV/c within limited kinematic ranges from 'tpp'<1.1 (GeV/c)^2 and 'tpΔ'<0.6 (GeV/c)^2, where full inclusive cross sections constitute σ(p)=6.27+-0.2 mbn and $\sigma(\Delta^{++})$=1.02+-0.2 mbn. The experimental data are obtained at irradiation of 4.7-m hydrogen bubble chamber "Mirabele" in the beam of HF-separated π^+-mesons of IFVE accelerator in Serpukhov. Energy dependence and factorized properties of full inclusive cross sections and inclusive spectra are discussed. A systematic difference between π^+p-and K^+-p-reactions at 32 GeV/c in the range

Msub(X)sup(2)<6 GeV² is found depending on average associated multiplicity <nsub(ch)> of charged particles in the reactions with proton on lacking mass square of a system X.

2712 **Hadron yields in interaction of 67 GeV/c protons with thick nuclear targets.** Bozhko, N.I.; Borisov, A.A.; Vovenko, A.S.; Volkov, A.A.; Glebov, V.Yu.; Kulikov, A.V.; Lapin, V.V.; Mukhin, A.I.; Salomatin, Yu.I.; Fakhrutdinov, R.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). *Yadernaya Fizika;* **31**: No. 5, 1246-1252(1980). (In Russian).

Results are presented on yields of π^{+-}, K^{+-} mesons, protons and antiprotons at interactions of 67-GeV/c protons with Al and Al_2O_3 targets used in the neutrino experiments at IHEP. The measurements were carried out in the angle interval of 0-50 mrad and in the momentum range of 4-60 GeV/c. Comparison of some data of the above experiment (with allowance for the absorption of secondary particle in targets) on yields of π^{+-} mesons and protons out of thick and thin targets, was carried out. Comparatively weak dependence of secondary particle yields on a target length at its change in the range of (1-2)lambdasub(ab.) (absorption wave length) is revealed with the help of the above analysis.

2713 **Study on the Ksub(L)sup(0) $\rightarrow \pi^{+-}\mu^{+-}\nu$ decays.** Birulev, V.K.; Vestergombi, G.; Genchev, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Yadernaya Fizika;* **31**: No. 5, 1204-1213(1980). (In Russian).

The filmless spark spectrometer placed in the channel of the Serpukhov accelerator was applied to detect approximately 150000 decays Ksub(L)sup(0) $\rightarrow \pi^{+-}\mu^{+-}\nu$. The dependnece of the form factors fsub(+) and f which enter the decay matrix element upon the square of the 4-momentum transferred to the leptonic pair was treated in the V-A theory, the squared 4-momentum transfer range being 0.01 to 0.11 (GeV/c)². The linear expansion parameters have been found to equal lambdasub(+)sup(μ)=0.0427+-0.0044; lambda$_0$=0.0341+-0.0067. The values of the parameters lambdasub(+)sup(μ), lambda$_0$ and xi=fsub(-)/fsub(+) are compared with various theoretical models. Comparison of the parameter lambdasub(+)sup(μ) with the analogous value of the parameter lambdasub(+)sup(e) obtained from the analysis of the Ksub(L) $\rightarrow \pi^{+-}e^{+-}\nu$ decayes detected in the same experiment (lambdasub(+)sup(e)=0.0306+-0.0034) gives indication for possible violation of the μe universality in semileptonic decays of kaons.

2714 **Correlations of secondary pions, produced in multinucleon interactions of πp mesons with carbon nuclei at p=40 GeV/c.** Batskovich, S. (Institut za Fiziku, Belgrade (Yugoslavia)); Grishin, V.G.; Jehnik, L.; Kanarek, T. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Yadernaya Fizika;* **31**: No. 5, 1234-1239(1980). (In Russian).

Correlation functions for two- and three-particle inclusive processes in π^-p, π^-n, and π^- ^{12}C collisions at p=40 GeV/c are obtained. The correlations of secondary pions are investigated in the rapidity as well as in the azimuthal angle. The experimental results are compared with predictions of the eikonal model and of the additive quark model and confirm the predictions of additive quark model.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 2669, 2669, 2709, 2714, 2799, 2802, 2807, 2875, 2921

2715 (INIS-mf—6542, pp vp) **Scattering theory for the coupled πNN-NN systems.** Avishai, Y. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics); Mizutani, T. (IPN, F91406 Orsay Cedex, France). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2716 (JINR-D—1,2-12450, pp 138-173) **Drell-Yan dileptons and associated hadrons.** Schubelin, P. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France)). 1979. Dep. NTIS (US Sales Only).

In 12. International school on high energy physics for young scientists.

Major theoretical and experimental studies conducted since 1960 on direct lepton production in hadronic interactions are reviewed. The original simple version of the Drell-Yan model based on the Feynman parton model for deep inelastic weak or electromagnetic processes is considered at length. According to the model the lepton pairs are produced via parton-antiparton annihilation at large transverse momenta. Recent modifications and improvements of the model are also presented. Influence of dilepton production on average multiplicity of associated hadrons is discussed. The current experimental situation in respect to existing or forthcoming data mainly on pN and πN reactions is described, and requirements to experimental set-up to measure, e.g. associated hadrons to Drell-Yan pairs, are formulated. It is concluded that the Drell-Yan model is in very good shape.

2717 (JINR-D—12831, pp 253-273) **Structure of short-range electromagnetic interactions.** Kadyshevskii, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

The possibility of gauge-invariant formulation of quantum electrodynamics (QED) adapted to new geometric conditions in terms of the de Sitter p-space geometry is considered. A new concept of the local gauge transformation and the 5-potential of an electromagnetic field is proposed. The free Dirac field theory has been formulated in a five-dimensional space. The presence of non-minimal terms in the lagrangian has been shown to change radically the usual presentations on the structure of electromagnetic short-range interactions. The developed scheme after the process of quantization is applied for describing the electron-muon electromagnetic interactions, since the QED has achieved a striking agreement with the experimental data. This scheme, as a gauge field theory, is characterized by use of a five-dimensional configuration space for localizing the gauge group SUsub(tau)(2) and by the internal dependence of this group on the fundamental length.

2718 (KFTI—79-48, pp 8-9) **Calculation of pion photoproduction amplitudes in the frameworks of the Pade approximation method.** Lebedev, A.I.; Mangazeev, B.V. (AN SSSR, Moscow. Fizicheskij Inst.). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

The Pade approximation method is applied for approximate summation of the iterative series obtained from the dispersion relations for the nonresonance multipole amplitudes of the $\gamma N \rightarrow \pi N$ process. The amplitudes calculated satisfactorily agree with the experimental data for the energy range of the first nucleon resonance photoexcitation.

2719 (KFTI—80-6, pp 84-85) **Measuring of electron longitudinal polarization by coherent bremsstrahlung.** Potylitsyn, A.P. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

The process of coherent bremsstrahlung is suggested to use for measuring electron longitudinal spin orientation. It is shown that the analyzing process power does not depend on the azimuthal angle of photon escape, therefore when detecting photons throughout the radiation cone, the analyzing power is not zero. The collimation effect on the analyzing power has been examined.

2720 (KFTI—80-6, pp 3-5) **Discrimination of pion photoproduction on ^{12}C with formation of residual decaying nuclei.** Kashevarov, V.L.; Pavlyuchenko, L.N.; Rzhanov, E.V.; Rylov, S.V.; Sokol, G.A. (AN SSSR, Moscow. Fizicheskij Inst.); Stukov, O.I.; Tomchakov, V.K. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1980. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

An experiment is described, as well as the results on discriminating the partial transitions in pion photoproduction on ^{12}C accompanying by production of residual niuclei undergoing γ-decay. The experiment was performed at the 700 MeV "Pakhra" electron accelerator. The use was made of the technique based on detecting secondary γ-quantum emitted by a nucleus product in coincidence with π-meson. A range scintillation telescope was used for detecting π-mesons, while a Ge(Li) detector was employed for detecting secondary γ-quanta. Energy and time resolutions of the Ge(Li) gamma spectrometer were 10 keV and 8 ns respectively at counting rates up to 10^5 p/s. In the spectrum of $\pi\gamma$-events, a peak corresponding to $\pi\gamma$-coincidence is observed, which suggests the possibility of recording and discriminating the reaction mentioned above by the partial transition method.

2721 **Composite gauge fields.** Bitar, K.M. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **24**: No. 10, 2654-2660(15 Nov 1981).

In analogy with the SU(N) two-dimensional σ model we discuss models in which composite gauge fields arise. We show that it is possible to construct Abelian as well as SU(2) composite gauge fields from the interactions of constituent scalar fields.

2722 **Continuum regulation of the strong-coupling expansion for quantum field theory.** Bender, C.; Cooper, F.; Kenway, R.; Simmons, L.M. Jr. (Washington University, St. Louis, Missouri 63130). *Physical Review [Section] D: Particles and Fields;* **24**: No. 10, 2693-2705(15 Nov 1981).

We study two continuum methods of regulating the formal strong-coupling expansion of the Green's functions, obtained by expanding the path integral in powers of the kinetic energy (inverse free propagator). Our continuum regulations amount to introducing either a hard (θ function) or soft (Gaussian) cutoff Λ in momentum space. The cutoff takes the place of the usual spatial cutoff, the lattice spacing, which arises when the path integral is defined as the continuum limit of ordinary integrals on a Euclidean space-time lattice. We find, by investigating free field theory and gphi^4 field theory in one dimension, that the θ-function regulation is more accurate than the Gaussian and, unlike the Gaussian, preserves certain continuum Green's function identities. The extension to field theories with fermions is trivial and we give the strong-coupling graphical rules for an arbitrary field theory with fermions and bosons in d dimensions.

2723 **Continuum strong-coupling expansion for quantum electrodynamics.** Cooper, F.; Kenway, R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] D: Particles and Fields;* **24**: No. 10, 2706-2723(15 Nov 1981).

We derive from the path integral a continuum strong-coupling expansion for QED in d-dimensional Euclidean space-time. It s a double expansion in the fermion and boson kinetic energy (inverse free propagators), which leads to a double power series for the Green's functions of the cutoff theory in terms of $1/e^2$ and Λ^2/M^2. Λ is a smooth cutoff in Euclidean momentum space, and M is an infrared regulator mass for the photons needed to define the local part of the path integral. We demonstrate how dimensional continuation is necessary to control the broken gauge invariance of the cutoff theory. Restricting to d = 2 (the Schwinger model) we show how to remove the cutoff using Pade approximants. We find some evidence that as $\Lambda^2/M^2 \to \infty$ gauge invariance is restored and we calculate the vector-mean mass, keeping the first three terms in the expansion in powers of the bare photon inverse propagator.

2724 **Fermionic contribution to Λ/sub lattice/.** Celmaster, W.; Maloof, D.J. (Northeastern University, Boston, Massachusetts 02115). *Physical Review [Section] D: Particles and Fields;* **24**: No. 10, 2730-2743(15 Nov 1981).

The ratio Λ/sub MO//Λ/sub latt/ is computed for quantum chromodynamics (QCD) with massless fermions present. The result obtained, using the Wilson form of the lattice action, is Λ/sub MO//Λ/sub latt/ = 117.5. We show how our methods can readily be extended to other forms of the action. Appendices give details of the technology of QCD perturbation theory on the lattice. Included are derivations of Feynman rules and Ward identities as well as general power-counting arguments and a discussion of the renormalization group.

2725 **Topological theory of electroweak vector bosons.** Chew, G.F.; Finkelstein, J.; Poenaru, V. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **24**: No. 10, 2764-2765(15 Nov 1981).

By allowing active charge arcs to be oriented independently of the quantum triangles on which they end, the topological theory of electromagnetism is extended to encompass electroweak interactions. The additional elementary particles may be identified as Z_0, W^{+-} as well as neutrinos.

2726 **Direct coupling of the pion in large-p/sub T/ jet interactions.** Berger, E.L.; Brodsky, S.J. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] D: Particles and Fields;* **24**: No. 9, 2428-2432(1 Nov 1981).

We emphasize a new class of high-transverse-momentum collisions in which the entire energy of an incident meson is delivered into production of a pair of large-p/sub T/ jets at large angle, with no final-state particles emerging along the beam axis. Simple two-body kinematics govern the reaction, with the longitudinal and transverse momentum of the second jet being specified uniquely in terms of those of the trigger jet. The quantum-chromodynamic subprocess which mediates the collision involves the direct coupling of the incident meson, and it is normalized absolutely in terms of the pion form factor F/sub π/(Q^2).

2727 **Factorization and its applicability in weak nonleptonic processes.** Galic, H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **24**: No. 9, 2441-2456(1 Nov 1981).

The role of the weak effective Hamiltonian in nonleptonic physics is studied. The application of the short-distance technique in simple pole transitions in mesons is justified. The amplitude, which is proportional to the matrix element of the Hamiltonian, is shown to be factorizable into a product of a coefficient function (hard part) and a matrix element of some local operator (soft part). The proof for such a factorization, valid to any order in the perturbative calculation, is given. The problems encountered in the evaluation of soft parts are presented. The use of a similar procedure in more complicated weak transitions is questioned, and a discussion of the predictive power of the effective Hamiltonian approach is included.

2728 **Hadron polarization in heavy-lepton decays.** Brau, J.E.; Tarnopolsky, G.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **24**: No. 9, 2521-2522(1 Nov 1981).

In the decay of the tau lepton into a spin-one meson and a neutrino, the meson state with helicity opposite its charge is forbidden by angular momentum conservation if the decay is mediated by the conventional V-A current. The laboratory momentum distribution of pions in the decay chain tau→rhoν, rho→$\pi\pi$ reflects the polarization of the rho meson and provides an experimental check of the nature of the decay current. This method requires the identification of the decay mode rhoν but does not depend on finding the tau laboratory direction.

2729 **Note on the neutrino mass matrix.** Terry, D.C.; Kuo, T.K. (Physics Department, Purdue University, West Lafayette, Indiana 47907). *Physical Review [Section] D: Particles and Fields;* **24**: No. 9, 2523-2525(1 Nov 1981).

A general analysis of the Gell-Mann—Ramond—Slansky model for the neutrino mass matrix is carried out. Assuming that there is a "generation structure" for the Dirac mass matrix, and that all of the eigenvalues of the Majorana mass matrix are large, it is found that rather small neutrino mixing angles are expected.

2730 **Massive neutrinos and the stellar stopping power via the neutrino magnetic moment.** Rustgi, M.L.; Leung, P.T.; Turner, J.E.; Brandt, W. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review* [*Section*] *A: General Physics;* 24: No. 5, 2425-2430(Nov 1981).

An exact expression is derived within the high-Q approximation for the spectrum of energy losses of neutrinos interacting with electrons via their magnetic moment. The new expression, which differs somewhat from the often used one published by Bethe, is used to calculate the neutrino magnetic moment upper limit. Our calculation confirms the neutrino magnetic moment upper limit reported by Cowan and Reines, although we use the antineutrino spectrum, and our new expression for the inelastic-scattering cross section. A formula for the stopping power of matter for neutrinos is derived and applied to study the solar-neutrino anomaly. The total cross section for ionization is obtained. An estimate indicates that the thermalization distance for stellar neutrinos exceeds the radius of the universe by many orders of magnitude.

2731 **Zero-entropy bootstrap and the fine-structure constant.** Chew, G.F. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* 47: No. 11, 764-767(14 Sep 1981).

"Topological supersymmetry," a newly recognized feature of the zero-entropy S-matrix bootstrap, leads to a zero-entropy coupling constant g_0 whose order of magnitude is controlled by the relation 8N/sub g/(8N/sub g/-1)$g^2_0/16\pi^2 \sim 1$, where N/sub g/ = 4 is the number of quark generations. A unification principle, suggested by electromagnetic extension of topological theory and encouraged by this relation, is $g_0 = e$. The posture of this unifying S-matrix condition with respect to field-theoretical grand unification is discussed.

2732 **Topological theory of elementary-hadron coupling constants.** Chew, G.F.; Finkelstein, J.; Levinson, M. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* 47: No. 11, 767-770(14 Sep 1981).

Topological particle theory is applied to the computation of elementary-hadron coupling constants. All are determined through topological supersymmetry by a single dimensionless "zero-entropy" constant g_0. The predicted coupling-constant ratios encompass and justify those of Mandelstam. The universality conjecture, $g_0 = e$, is supported (to 6%) by the accurately measured value of the pion-nucleon coupling constant. An explanation emerges for the experimental failure to find baryonium.

2733 **Power corrections at short distances.** Politzer, H.D. (California Inst. of Tech., Pasadena (USA)). *Nuclear Physics* [*Section*] *B;* 172: No. 2/3, 349-382(Sep 1980).

Hadronization psub(transverse) smearing, and higher twist are analzed in terms of a factorization theorem that represents all hard scattering processes as a power series in $1/Q^2$, the common large momentum scale. Process-independent functions are convoluted with perturbative amplitudes in an algorithm that rests on the equations of motion.

2734 **Hadronic production of J/psi associated with a gluon.** Chang, C.H. (European Organization for Nuclear Research, Geneva (Switzerland)). *Nuclear Physics* [*Section*] *B;* 172: No. 2/3, 425-434(Sep 1980).

A mechanism for hadronic production of J/psi associated with a gluon is discussed. This mechanism contributes a few percent to the measured production. In order to understand this mechanism we also calculate another example, namely the hadronic production of etasub(c) associated with a gluon.

2735 **Polarization effects in the inclusive process $e^+e^- \rightarrow \Delta X$ in the non-perturbative parton model.** Khachatryan, G.N.; Shakhnazaryan, Y.G. (AN Armyanskoj SSR, Erevan. Inst. Fiziki). *Nuclear Physics* [*Section*] *B;* 172: No. 2/3, 435-444(Sep 1980).

The scaling behaviour of all ten structure functions describing the inclusive process $e^+e^- \rightarrow \Delta X$ in the general case, when there is no summation over nucleon isobar polarizations, is found. The investigation is carried out on the basis of the non-perturbative parton model. In the Bjorken scaling limit, the expressions for the angular distribution of the $\Delta \rightarrow N\pi$ decay products, and the longitudinal polarization vector of a nucleon in this decay, as well as for the isobar polarization vector, are obtained.

2736 **Drell-Yan model at measured Q/sub T/. Asymptotic smallness of one-loop corrections.** Ralston, J.P.; Soper, D.E. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). *Nuclear Physics* [*Section*] *B;* 172: No. 2/3, 445-457(Sep 1980).

We discuss the Drell-Yan model for dimuon production with measured dimuon transverse momentum. We calculate the leading effect on the dimuon Qsub(T) distribution arising from the first corrections to the q* + anti q* $\rightarrow \gamma^*$ + X Green function in axial gauge quantum chromodynamics. These corrections are found to be negligible in the appropriate high-energy limit. We also present a useful theorem for transforming between transverse momentum and position in the high-energy limit.

2737 **QCD and valence-quark approximation for non-leptonic decays of baryons.** Cortes, J.L. (Zaragoza Univ. (Spain). Dept. of Functional Equations); Sanchez Guillen, J. (Zaragoza Univ. (Spain). Dept. de Fisica Atomica y Nuclear). *Nuclear Physics* [*Section*] *B;* 172: No. 2/3, 534-542(Sep 1980).

In the valence-quark approximation relevant for the QCD approach to hadronic weak decays, we consider all quark diagrams directly, without soft pions. The analysis tests the consistency of the approximation and is in qualitative agreement with previous estimates for S-waves, but it has new predictions, which for the P-waves of Σ^- and $\Omega \rightarrow \Lambda K$ indicate a clear conflict between aspects of the standard approach and experiment.

2738 **Particles, quarks, leptons and coloured glue.** Ryder, L. (Kent Univ., Canterbury (UK)). *Physics Education;* 15: No. 4, 211-217(Jul 1980).

In considering the current situation in particle physics it is shown that protons and neutrons are no longer thought of as fundamental, they are made of quarks, and pions are no longer thought of as being agents of the nuclear force, as the proper agents of the strong force are gluons. The subject is examined under the headings; the Bohr atom and beta decay, particle population explosion, quarks, leptons and gauge fields, partons, coloured gluons, and electroweak interaction. Having given a picture of the presently envisaged fundamental particles the outstanding problems are listed.

2739 **Extensive survey of the characteristics of pseudorapidity distributions in hadron-nucleus collisions at high and ultra high energies.** Ghosh, D. (Jadavpur Univ., Calcutta (India). Dept. of Physics). *Annalen der Physik (Leipzig);* 37: No. 3, 183-188(Jun 1980).

This paper presents an extensive study of the nature of the pseudorapidity distribution in hadron-nucleus collision in emulsion from accelerator energy to super high cosmic ray energies (24 GeV/c to 4 TeV). The energy and the target dependence of the distributions and their possible significance are also discussed.

2740 **anti NN, πanti NN and $\pi\pi$anti NN bound states by anti NN potentials.** Ueda, T. (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). *Progress of Theoretical Physics (Kyoto);* 63: No. 1, 195-202(Jan 1980).

Using the anti NN potential whose real part is the transformation from Ueda-Green NN OBEP and the imaginary part is a phenomenological parametrization representing peripheral annihilation, we study anti NN, pi anti NN and pi pi anti NN bound states. The pi anti NN and pi pi anti NN states are considered in analogy with the pi NN and pi pi NN bound states which explain the dibaryon experimental evidence. A lot of barionium states which have narrow widths as 10 MeV as well as broad widths as 300 MeV are generated. However the result is far from allowing us quantitative comparison with experimental evidence.

2741 Local number fluctuation in multi-particle production. Miyamura, O. (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 203-216(Jan 1980).

The local number fluctuation which has recently been introduced is discussed from the viewpoint of identical particle effect and kinematical clustering. In frameworks of concrete models, explicit expressions for the fluctuation are given and examined quantitatively as well as qualitatively. It is shown that the recently observed large fluctuation for like pions is naturally explained as identical particle effect. A restriction to number distribution of hadrons in a cluster from the data of local number fluctuation is also pointed out.

2742 Faddeev approach to the $^3F_3$ diproton in πNN dynamics. Araki, M.; Ueda, T. (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science); Koike, Y. *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 335-337(Jan 1980).

2743 Lowest ($1/2^+$ and 0^-) hadron masses and the behavior of the constituent quarks. Miura, K. (Nippon Medical School, Tokyo). *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 347-350(Jan 1980).

2744 Lorentz transformation for quark processes. Koshiba, M. (Tokyo Univ. (Japan). Faculty of Science). *Journal of the Physical Society of Japan;* **48**: No. 1, 1-3(Jan 1980).

Based on the existing experimental data it is suggested that one can raise a serious doubt about the validity of Lorentz transformation for those processes in which high energy quarks interact with the hadronic sea.

2745 ΣYafc^{+-} resonance production in the inclusive pp interactions. Takibaev, Zh.S.; Golyak, I.G.; Sharapov, N.I. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij). *Yadernaya Fizika;* **31**: No. 4, 967-973(1980). (In Russian).

Investigated are the processes of $\Sigma_{1380}{}^{+-}$ resonance inclusive production in pp-interactions at high ener.gies by means of the model, based on the use of quantum-mechanical representation on minimized wave function. Cross sections of meson and baryon inclusive production in p+p→c+x reactions are studied. Graphically presented are comparative results of experimental and calculation data analysis for cross section of inclusive $\Sigma_{1385}{}^{+-}$ hyperon production, as well as distributions of the observed resonances by the square of their transverse momentum and by Feinmann variable with 12 and 24 GeV/c proton beam momentum. It is shown that distributions on Feynmann variable are essentially different for $\Sigma_{1385}{}^{+}$ and $\Sigma_{1385}{}^{-}$ resonances. It is concluded that the obtained calculation data are in a good aqreement with experimental ones and they do not contradict suppositions of the additive quark model.

2746 Electromagnetic formfactors of the V→P$\mu^+\mu^-$ decays of vector mesons in the bag model. Martem'yanov, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). *Yadernaya Fizika;* **31**: No. 4, 999-1002(1980). (In Russian).

In the bag model obtained are radiation decays of vector mesons, in which virtual photon converts in $\mu^+\mu^-$ pair. Formfactors of vector-into-pseudoscalar meson transition within the range of g^2 momenta time-like transfer are calculated for rho → $\pi\mu^+\mu^-$, $\omega \rightarrow \pi\mu^+\mu^-$, $K^{+*} \rightarrow K^+\mu^+\mu^-$, $K^{0*} \rightarrow K^0\mu^+\mu^-$ and psi → eta$\mu^+\mu^-$ decays Distributions of decay probabilities by the invariant mass of $\mu^+\mu^-$ pair and full probabilities GITA(V → P$\mu^+\mu^-$) are found. Calculation results of formfactors in the bag model are presented graphically and they are compared with suppositions for the formfactors in the vector dominance model. It is shown, that they essentially differ in $\omega \rightarrow \pi\mu^+\mu^-$ and $g \rightarrow \pi\mu^+\mu^-$ decays and they are similar in other decays. However, differences slightly effect differential momentum distributions and widths GITA(V → P$\mu^+\mu^-$).

2747 Resonance production in the hydrodynamical model. Daibog, E.I.; Murzin, V.S. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). *Yadernaya Fizika;* **31**: No. 4, 1048-1052(1980). (In Russian).

Presented is a modified hydrodynamic model for the cross section set description of PI$^-$, rho^0, ω, f, eta particle direct production, secondary particle composition and their distributions on the square of transverse momentum. The suggested model presupposes, that production of every particle type takes place at the temperature T approximately M, but the produced particles continue to cool down, participatin.o in adiabatic expansion of the hydrodynamic model. This approach permits to take account of resonance production within the frames of the hydrodynamic theory; it does not contradict experimental data and it approximately describes their set.

2748 Calculation of the asymptotics of the pion electromagnetic form factor in QCD perturbation theory. Chernyak, V.L.; Serbo, V.G.; Zhitnitskii, A.R. (AN SSSR, Irkutsk. Sibirskij Inst. Zemnogo Magnetizma Ionosfery i Rasprostraneniya Radiovoln). *Yadernaya Fizika;* **31**: No. 4, 1069-1082(1980). (In Russian).

The results of diagram direct calculation of excitation theory for the pion electromagnetic formfactor are presented to control predictions of the earlier described qeneral method of hadron formfactor asymptotic finding in quantum chromodynamics. Given is a detailed calculation of the main logarithms of one- and two-loop diagrams of pion formfactor and the results of their expansion of excitation theory. Parton interpretation of the obtained decays in the main logarithmic approximation is described. It is shown, that parton contribution to the hadron formfactor asymptotics is gradually suppressed. Calculation results are in an aqreement with predictions of the general method.

2749 Measurement of mean energy of charged particles in c.m.s. for anti pp interactions at 22.4 GeV/c. Boos, E.G.; Ermilova, D.I.; Samolov, V.V. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij). *Yadernaya Fizika;* **31**: No. 4, 947-955(1980). (In Russian).

A method is proposed for mass-independent calculation of average energy of charged particles in c.m.s. for the c.m.s.-symmetrical reactions. The corresponding analysis is carried out for inelastic anti pp interactions at 22.4 GeV/c. The dependence of the energy fraction taken away by charged particles etasub(ch) on the multiplicity and on the transverse momentum is investigated. The average value is etasub(ch)=0.633+-0.004. Comparing with the pp-interaction data, an estimate for the annihilation channel is obtained etasub(ch)sup(A)=0.47+-0.11. A linear dependence of the average number of neutral particles on the multiplicity for n<=10 is established.

2750 P-odd asymmetry of single-pion production by longitudinally polarized electrons on nucleons. Ishankuliev, D.; Safin, M.Ya. (Moskovskij Gosudarstvennyj Univ. (USSR)). *Yadernaya Fizika;* **31**: No. 4, 993-998(1980). (In Russian).

Differential cross section and P-odd asymmetry of the single-pion production on nucleons by longitudinally polarized electrons in the region of Δ(1236) resonance excitation are calculated taking into account the interference of the weak neutral and electromagnetic currents. Numerical predictions for the asymmetry are obtained in the framework of several gauge models based on SU(2)xU(1) and SU(3)xU(1) groups.

2751 Ksub(L) → 2π decays in the six-quark model. Prokhorov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). *Yadernaya Fizika;* **31**: No. 4, 1019-1023(1980). (In Russian).

In framework of a model with three quark doublets the difference of the CP-breaking parameters for the decays Ksub(L) → $\pi^+\pi^-$ and Ksub(L) → $\pi^0\pi^0$ is found and expressed in terms of the heavy quark masses and the mixing angles.

2752 Weinberg model of the CP breaking and T-odd correlations in weak decays. Zhitnitskii, A.R. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). *Yadernaya Fizika;* **31**: No. 4, 1024-1035(1980). (In Russian).

A modified model, proposed by Weinberg for the CP-breaking in gauge theories with account of an additional U(1) symmetry and with a previously proposed mechanism for suppression of the axion-hadron interactions, is considered. T-odd correlations for leptonic decays of hadrons are calculated in the model. It is shown that in a number of cases the magnitude of the CP-breaking effect is comparable with the simulating background from electromagnetic interactions. Transversal polarization of muons from the Ksub(μsub(3))sup(-) decay, due to both the CP breaking and to the electromagnetic interaction, is calculated. In this case the background is essentially less than the true CP-breaking effect, and an observation of the muon transversal polarization at a level of about 10^{-3} would be an evidence of the CP-parity nonconservation.

2753 Neutral current problem in the united E_7 theory. Lednitskii, R. (Joint Inst. for Nuclear Research, Dubna (USSR)); Tseitlin, V.Yu. (AN SSSR, Moscow. Fizicheskij Inst.). *Yadernaya Fizika;* **31**: No. 4, 1036-1047(1980). (In Russian).

It is shown that in the E_7 theory of the grand-unification a possibility exists to describe the weak and electromagnetic interactions by the gauge group SU(2)x[U(1)]. In this case the E_7 theory is in good agreement with all available data and makes specific predictions which can be soon tested in the anti pp and e^+e^- annihilation and μ-nucleon scattering experiments being prepared.

2754 Correlations between partons in QCD. Gedalin, E.V. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). *Yadernaya Fizika;* **31**: No. 5, 1372-1380(1980). (In Russian).

Two-particle correlation functions of partons in partons and hadrons are calculated along with the two-particle correlation function of hadrons in jets produced by quarks and gluons. It is shown that at large momentum transfer the correlations between particles in QCD are determined by the evolution of the parton cascade. At small momentum portions of a parton it results in long-range correlations between particles.

2755 Coherent interaction of neutrino with dense matter. Varfolomeev, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Yadernaya Fizika;* **31**: No. 5, 1268-1275(1980). (In Russian).

Inelastic and elastic scattering of neutrino on atoms of the matter and neutrino-antineutrino pair photoproduction induced by neutral lepton currents are considered. It is shown that in the above processes coherent interaction with macroscopic volumes of the matter are possible. The factor which characterized the increase of the reaction yield due to the coherent processes is proportional to the matter density. It is noted that taking into account the coherent processes may change our view on the role played by low-energy neutrino in astrophysics.

2756 Effect of scalar and tensor interaction on atomic decay of neutron n → H+anti ν. Nemenov, L.L.; Ovchinnikova, A.A. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Yadernaya Fizika;* **31**: No. 5, 1276-1278(1980). (In Russian).

The influence of the scalar and tensor admixtures to V-A interactions on the probability of the hydrogen emission in various spin configurations for the atomic decay of the neutron n → H+anti ν is treated. Measurement of the probability of emission of atoms with positive electron and proton helicities is a sensitive method of discovering the scalar interaction admixture to V-A Hamiltonian.

2757 Production of charm particles in νN collisions due to weak neutral currents. Rekalo, M.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Yadernaya Fizika;* **31**: No. 5, 1295-1305(1980). (In Russian).

Associative production of charmed particles in neutrino-nucleon collisions due to neutral weak currents is considered. Angular distribution of jets of charmed hadrons in the νN interactions is obtained in the lowest approximation in the quark-gluon coupling constant, so that the charmed quark-antiquark pair is produced from annihilation of the vector gluon with a virtual Z boson. It is shown that only the P-even dependence on the azimuthal angle PSI arises, as for the P-odd dependence, possible in the general situation, it does vanish. The total cross section of production of charmed particles in the neutrino-nucleon interaction is calculated and the reason for a breaking of the scale invariance is shown.

2758 Diagonality of the weak neutral current and of the mixing amplitudes of neutral mesons. Volkov, G.G.; Liparteliani, A.G.; Nikitin, Yu.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). *Yadernaya Fizika;* **31**: No. 5, 1306-1317(1980). (In Russian).

The possibility of mixing of neutral systems of the type K^0 reversible anti K^0 and D^0 reversible anti D^0 is studied in the multiquark gauge models of weak interactions. An essential use is made of the diagonality of the neutral weak current. Calculation of the mixing amplitude in the forth order of the perturbation theory is carried out in the unitary gauge and in the approximation of zero four-momenta of the final fermion lines in the corresponding Feynman graphs. Unified formulas are derived for the mixing amplitudes of the mesons under consideration as well as for the corresponding mass differences of long- and short-lived components of the mesons under consideration in the models which involve 2n quarks (n=3,4 doublets).

2759 Radiative decays of C-even mesons. Budnev, V.M.; Kaloshin, A.E. (AN SSSR, Novosibirsk. Inst. Matematiki). *Yadernaya Fizika;* **31**: No. 5, 1318-1323(1980). (In Russian).

The estimates of radiative widths GITA(R → γγ) for mesons Jsup(PC)=0^{-+}, 0^{++}, 2^{++} and GITA(0^+ → rhoγ) are presented. The results are used for the analysis of MARK-2 data on γγ → eta' → rhoγ, it is shown that the delta and Ssup(•) production background is small. The analysis of available GITA(0^- → γγ) data within SU(3) and VDM framework indicates the necessity for a larger value of GITA(eta → γγ) than the conventional one. The comparison with data of other works confirms Jsub(eta')=0.

2760 NN scattering in nonrelativistic quark model. Belyaev, V.B.; Pupyshev, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Yadernaya Fizika;* **31**: No. 5, 1324-1331(1980). (In Russian).

A dynamical description of the two-nucleon scattering is attempted in framework of the nonrelativistic theory of the six-body system. The quark confinement condition enables one to approximate the quark Hamiltonians in each of the nucleons by means of finite-rank operators. Such an approximation makes it possible to solve the problem in two steps. First, an auxiliary problem is solved, that of scattering of three fixed (in a nucleon) quarks on three fixed (in another nucleon) quarks. Further, it is shown that the amplitude of the elastic NN scattering satisfies a one-dimensional integral equation with a kernel containing the t matrix of the auxiliary problem. The last equation is solved numerically; the energy dependence of the s-wave phase shift and of the total elastic scattering cross section is obtained.

2761 Description of the mass spectrum and Regge trajectories of mesons on the base of relativistic two-particle quasipotential equation. Skachkov, N.B.; Solovtsov, I.L. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Yadernaya Fizika;* **31**: No. 5, 1332-1341(1980). (In Russian).

The three-dimensional relativistic two-particle quasipotential equation written in the relativistic configurational representation is used to describe the mass spectrum and Regge trajectories of mesons. The quasipotential equation is solved by the WKB model. We obtain the relativistic analog of the modified WKB quantization condition which simplifies the study of the meson Regge trajectories. Formulae are derived for the lepton decay widths. The results are compared with experiment.

2762 Flavor mixing and proton instability in the grand unification schemes. Asatryan, G.M.; Matinyan, S.G. (Erevanskij Fizicheskij Inst. (USSR)). *Yadernaya Fizika;* **31**: No. 5, 1381-1387(1980). (In Russian).

Flavour mixing in the quark currents connected with baryon number nonconservation, is investigated in framework of the unified models of weak, electromagnetic and strong interactions based on the groups SU(5) and SO(10). Equations are obtained relating the mixing parameters in these currents, as well as those in the left and right charged currents. It is shown that in the SO(10)-symmetric model with six quarks it is impossible to get the stable proton by means of the flavour mixing in the quark sector: the proton decay probability may be suppressed at best by a factor of sin²THETAsub(C), where THETAsub(C) is the Cabibbo-angle.

2763 **Antinucleon-nucleon potentials for bound and scattering states.** Ueda, T. (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1670-1690(Dec 1979).

anti NN potentials which describe non-resonant part of scattering data at low energies (E sub(l) lt = 600 MeV) are presented. Their real components are determined by the Ueda-Green NN OBEP. About their imaginary components we consider two types of impact structure corresponding to central and peripheral annihilations. Using the potentials we study anti NN bound states. As a result we find that the anti NN potential associated with the peripheral imaginary component is in favor for explaining both bound and scattering data including the barionium states with narrow decay widths.

2764 **ΣN bound state and the Λp enhancement in the reaction $K^- d \to \pi^- \Lambda p$.** Mizuno, T. (Tokyo Univ. (Japan). Coll. of General Education). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1691-1703(Dec 1979).

The enhancement in the lambda p mass distribution in the reaction K⁻ d → pi ⁻ lambda p is analyzed using the impulse approximation for the reaction and one-boson-exchange potentials for nucleon-hyperon interactions. The observed sharp peak near the $\Sigma^+ n$ threshold is reproduced in this calculation and is interpreted as a quasi-bound state of a nucleon and a sigma hyperon. The calculated production cross section of the peak has a t-dependence which is consistent with experimental data.

2765 **Kinematical constraints imposed by cosmological baryon production.** Honda, M.; Yoshimura, M. (Tohoku Univ., Sendai (Japan). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1704-1712(Dec 1979).

Refined kinematical constraints are presented for heavy boson decay to generate a cosmological baryon asymmetry. A new possibility of baryon production via Higgs decay instead of gauge boson decay is closely examined.

2766 **Charm changing radiative weak decays in AFS model.** Pandit, P.N.; Verma, R.C.; Khanna, M.P. (Punjab Univ., Chandigarh (India). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1713-1717(Dec 1979).

Weak radiative decays ($1/2^+ \to 1/2^+$ + gamma) and ($1/2^+ \to 3/2^+$ + gamma) of charmed baryons are studied in the Abe, Fujii and Sato considerations.

2767 **Elastic scattering between binary quark-antiquark system and local field.** Sogami, I.; Nishimoto, S. (Kyoto Sangyo Univ. (Japan). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1768-1778(Dec 1979).

Elastic scattering between binary confined systems of quark and antiquark and local scalar field is examined within a revised framework of bilocal field theory. Scattering amplitudes arising from the exchanges of binary systems in s- and u-channels are derived in the lowest Born approximation. It is shown that the forward scattering amplitude has the exponential t-dependence for large s, and the amplitude of large fixed-angle collision decreases as s^{-2} with increasing energy.

2768 **Possible exotic charge or baryon number for heavy quarks.** Kaneko, T. (Meijo Univ., Nagoya (Japan)). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1779-1781(Dec 1979).

2769 **Decay angular distributions of the Z^0-boson produced in $e^+e^- \to Z^0\gamma \to mu^+\mu^-\gamma$.** Hayashi, M.; Katsuura, K. (Saitama Medical Coll., Moroyama (Japan)). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1781-1783(Dec 1979).

2770 **Pomeron coupling diagram up to order 1/N.** Koike, J. (Niigata Univ. (Japan). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1783-1785(Dec 1979).

2771 **Multiperipheral production of large and small fireballs at very high energies.** Hama, M.; Suzuki, H. (Rikkyo Univ., Tokyo (Japan). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1786-1787(Dec 1979).

2772 **Possible existence of a resonance in Σpp system.** Misra, J.N.; Goyal, D.P. (Delhi Univ. (India). Dept. of Physics and Astrophysics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1788-1789(Dec 1979).

2773 **Strong coupling constants in broken SU(3).** Kanwar, S.; Verma, R.C.; Khanna, M.P. (Punjab Univ., Chandigarh (India). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 4, 1152-1154(Oct 1979).

2774 **Unitarity constraint equations for Reggeon vertices and the finite mass sum rule.** Kubota, T. (Tokyo Univ. (Japan). Coll. of General Education). *Progress of Theoretical Physics (Kyoto);* **62**: No. 3, 713-726(Sep 1979).

The bootstrap equation for Reggeon vertices proposed by Konishi and Kwiecinski is derived by using the dual resonance model as a guide. The bootstrap equations for Reggeon propagators, Reggeon vertices and triple Regge couplings are shown to have the same theoretical footing, i.e., they can be derived from the condition of non-double counting in the unitarity summation. The constraints to be satisfied by the four-Reggeon vertex are also obtained by investigating the eight-point function.

2775 **Cluster cascade model for high energy hadron-nucleus collisions.** Suzuki, N. (Waseda Univ., Tokyo (Japan). Dept. of Physics); Suzuki, S. *Progress of Theoretical Physics (Kyoto);* **62**: No. 3, 727-737(Sep 1979).

Single particle distributions and two-particle correlations in high energy proton-nucleus collisions are studied by the use of cluster cascade model. It is shown in case of the independent emission of clusters, the average charged multiplicity from a cluster <k> is about 1.4, which is consistent with the analysis of p-p experiments and that charged particles emitted from different clusters make a marked contribution to the two-particle correlation in proton-nucleus collisions contrary to the case in p-p collisions. The mean free path of cluster in a nucleus is required to lengthen with the increase of the energy of incident particle to describe the energy dependence of experimental data.

2776 **Trajectory slopes in a gauge-dual-topological approach to soft hadronic reactions.** Minakata, H. (Tokyo Metropolitan Univ. (Japan). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 3, 738-749(Sep 1979).

Trajectory slopes of hadrons with different topological structure are investigated in detail from the QCD-inspired multi-jet view of hadronic final states. It is shown that the result by Rossi and Veneziano, α'sub(pomeron)/α'sub(reggeon) = α'sub(M_2sup(j))/α'sub(M_4sup(j)) = 1/2, has a remarkable stability under the general multiperipheral assumption for jets. It is also found that the non-logarithmic behaviour of the average multiplicity as a finite energy effect and the asymmetry of two jet multiplicities arising from that of quark momentum configuration are responsible for the reduction of the slope ratio to α'sub(p)/α'sub(r) = 1/4 -- 1/3, phenomenologically favoured value.

2777 **Quantum field theory of extended hadrons.** Yamaguchi, Y. (Tokyo Univ. (Japan). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 3, 750-778(Sep 1979).

A local quantum field theory of extended hadrons is developed. Hereby, a new form to second-quantize strongly interacting

fields is proposed. This formalism will be useful not only to discuss hadrons at rest and their excited states but also to apply it to nuclear structure theory and other fields of quantum physics when systems under consideration have bound states and/or strongly coupled states.

2778 **Charm-pair production in νN and pN collisions.** Hioki, Z. (Kyoto Univ. (Japan). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **62**: No. 3, 845-847(Sep 1979).

2779 **Allowed values of the quark magnetic charges in dyonic models of hadrons.** Satikov, I.A.; Strazhev, V.I. (Belorusskij Politekhnicheskij Inst., Minsk). *Yadernaya Fizika;* **30**: No. 5, 1379-1381(1979). (In Russian).

Restrictions are formulated for the possible magnetic charges of dyons, resulting from the Dirac charge quantization condition and with identification of the magnetic charge to the color quantum number.

2780 **Existence of local thermodynamical equilibrium in hadron collisions.** Zhirov, O.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). *Yadernaya Fizika;* **30**: No. 10, 1098-1108(1979). (In Russian).

A quark-gluon system is studied in detail at different stages of hydrodynamic spread. To indicate the range of applicability of the thermodynamic and hydrodynamic description formulated has been the fundamental property of the thermodynamic mechanism of production - universality of produced particles spectra as a function transverse mass and longitudinal rapidity. The boundaries of the range of the thermodynamic description have been indicated from the experimental data on universality and effective temperature of emission of particles with a definite mass. The equations of the hadron plasma states have been obtained in the assumption of scale invariance of hydrodynamic spread.

2781 **Numerical calculation of non-relativistic energy levels for the quarkonium.** Tateno, T. (Seikyo-gakuen High School, Kawachinagano, Osaka (Japan)); Sumikawa, M.; Nakanishi, M.; Mimura, O.; Kakudo, Y. *Osaka Kyoiku Daigaku Kiyo, 3;* **27**: No. 2, 87-92(Dec 1978).

The successes in charmonium spectroscopy by Eichten et al. using the nonrelativistic potential model seem to suggest some possibility of applying the same model to other problems in quarks. The purpose of this paper is to search the technique available for integrating the Schroedinger equation numerically and for determining the eigenvalue for the Eichten potential. Assuming the effective potential between the C and anti-C quarks to be the equation given by Eichten et al., the mass spectrum of the charmonium is obtained as the eigenvalues of the radial Schroedinger equation. The eigenvalues can be determined by solving the Schroedinger equation numerically, and by examining the behavior of the solution at large distance from the origin. The numerical solution of the eigenfunction was obtained by means of the Runge-Kutta's method. The mass spectrum for J/psi particles can be evaluated. The calculated mass spectrum of psi particles is shown in a table together with the observed values and Eichten's results. It seems that the present result is consistent with both of them.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 2701, 2752, 2762, 2801

2782 **Vanishing renormalization of the D term in supersymmetric U(1) theories.** Fischler, W.; Nilles, H.P.; Polchinski, J.; Raby, S.; Susskind, L. (University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review Letters;* **47**: No. 11, 757-759(14 Sep 1981).

The breaking of supersymmetry can be implemented by the D term. This term can be quadratically divergent, ruining the possibility of naturally large hierarchies. According to Witten this does not occur if the U(1) gauge group is unified in a semisimple group. We show that sufficient conditions for the D counterterm to vanish are less restrictive than grand unification and only require a vanishing trace of the U(1) charge. No cancellation between high-energy and low-energy scales is involved.

2783 **Quaternionic gauge fields on S^7 and Yang's SU(2) monopole.** Minami, M. (Kyoto Univ. (Japan). Research Inst. for Mathematical Sciences). *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 303-321(Jan 1980).

A regular connection 1-form is introduced on a 7-sphere, and gauge transformations are applied to it to produce two specific singular connections. The gauge potentials which these singular connections embody are shown to be identical with Yang's SU(2) monopole solutions as shown by pulling back the latter by a Hopf map eta_3: $S^7 \rightarrow S^4$. The study is a genuine generalization of a previous work where Dirac's U(1) monopole was discussed within the realm of the Hopf fibre-map $S^3 \rightarrow S^2$. The present discussion hence parallels the previous one; a major difference being only that the quaternions are used in place of the complex numbers.

2784 **Evidence for total number conservation of quarks in the D-meson decay.** Matsuda, M. (Aichi Univ. of Education, Kariya (Japan). Dept. of Physics); Nakagawa, M.; Ogawa, S. *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 351-353(Jan 1980).

2785 **Origin of horizontal symmetry and SU(5) x SU / sub f/(2) unification.** Yanagida, T. (Tohoku Univ., Sendai (Japan). Coll. of General Education). *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 354-356(Jan 1980).

6454 Field Theory

REFER ALSO TO CITATION(S) 2640, 2716, 2722, 2723, 2724, 2727, 2731, 2748, 2754, 2782, 2958

2786 (JINR-D—12831, pp 82-142) **Gravitational effects in the field theory of gravity.** Vlasov, A.A.; Denisov, V.I.; Logunov, A.A.; Mestvirishvili, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

Description of different gravitational effects of the gravitation field theory is considered. The postnewtonian approximation of this theory shows that all the parameters of the theory, with the exception of the parameter B, coincide with those of the Einstein theory. In the gravitation field theory no limitations are imposed on the value B. As it has been found from the correspondence of the predictions of the theory to the experimental results $B = 1$. Thus, gravitation field theory and the Einstein theory are indistinguishable from the point of view of any gravitational experiments, carried out with a postnewtonian accuracy in the gravitational field of the Solar system. As well as in the Einstein theory, the gravitational field of a non-static spherically-symmetrical source outside of matter is a static field. The non-stationary homogeneous models of the Universe in the gravitation field theory describe the cosmological red shift. Unlike the Einstein theory, the slowing down parameter is determined not only by the mean density of matter in the Universe, but by the postnewtonian coefficients as well. Therefore, there arise no difficulties in the gravitation field theory, which take place in the Einstein theory and are connected with small mean density of matter for obtaining the observed slowing down parameter.

2787 (JINR-D—12831, pp 178-185) **Ambiguity of current determination in the Thirring model.** Aneva, B.; Mikhov, S.; Stoyanov, D. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

It has been shown that in the Thirring model it is possible to obtain a more general determination of current, than the existing one. The determination results in the renormalized solutions of the model which form a one-parametric family. A set of vector currents obtained in this way assigns different methods for quantization of the Thirring model and, in particular, quantization with finite renormalization. It is shown that under this more general determi-

nation of current the conformed dimension of a two-point function is not fixed.

2788 (JINR-D—12831, pp 186-194) **Scale solutions in vector theories.** Arbuzov, B.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

An attempt has been made to formulate a new approach to renormalizable gauge theories. The approach is based on the possibility that the "scale solutions" of the fundamental equations of the quantum field theory can be realized asymptotically. The electrodynamics of vector particles is chosen as an example of renormalizable gauge quantum field theory. It is found that already in the first approximation the "scale solutions" can be realized only at some definite "eigenvalues" of the coupling constant. The value of the renormalized coupling constant obtained does not very much differ from the experimental value of the coupling constant in the Salam-Weinberg model. The discriminated values of the charge cannot be called its eigenvalues, since it is not shown that at other values of the charge there is no solution at all.

2789 (JINR-D—12831, pp 195-214) **Bogolyubov axiomatic method in quantum electrodynamics.** Bazhanov, V.V.; Pron'ko, G.P.; Solov'ev, L.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

A number of problems of quantum electrodynamics are reviewed which permit an exact solution for both strong and electromagnetic interactions. The solutions have been obtained in the framework of the S-matrix method based on the Bogolyubov axiomatic approach supplemented with some axioms which make it possible to extended the field of application of the Bogolyubov approach for quantum electrodynamics. Infrared "renormalization" of axioms and fundamental equations of the S-matrix electrodynamics is discussed. Low-energy theorems for matrix elements of radiative operators have been obtained as solutions of fundamental equations. The low-energy theorems are used for describing the electrodynamic phenomena of soft photons. The bremsstrahlung amplitude is found. A generalized threshold theorem is formulated for the Compton scattering amplitude. The results of examining the infrared asymptotics of the charged particle Green functions, the small-angle scattering of charged particles and electromagnetic effects on heavy narrow resonance production are presented. The problems discussed show that the consequences of general principles of the relativistic quantum theory supplemented with requirements on gauge invariance are essentially nontrivial.

2790 (JINR-D—12831, pp 247-252) **Tauber theorems in quantum field theory.** Vladimirov, V.S.; Zav'yalov, B.I. (AN SSSR, Moscow. Matematicheskij Inst.). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

Tauberian theorems are studied which relate the asymptotic behaviour of the generalized function in the neighbourhood of zero to the asymptotic behaviour of its Fourier transformation at infinity. The asymptotic properties of form factors and of the Wightman two-point function are examined. By a form factor in electron-nucleon scattering is meant a generalized function of slow growth F(g), g (g_0g vector). For description of the form factor asymptotic behaviour a natural scale of self-similar functions is used.

2791 (JINR-D—12831, pp 323-334) **Asymptotic series and functional integrals in quantum field theory.** Shirkov, D.V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

Investigations of the methods for analyzing ultra-violet and infrared asymptotics in the quantum field theory (QFT) have been reviewed. A powerful method of the QFT analysis connected with the group property of renormalized transformations has been created at the first stage. The result of the studies of the second period is the constructive solution of the problem of outgoing the framework of weak coupling. At the third stage of studies essential are the asymptotic series and functional integrals in the QFT, which are used for obtaining the asymptotic type of the power expansion coefficients in the coupling constant at high values of the exponents for a number of simple models. Further advance to higher values of the coupling constant requires surmounting the difficulties resulting from the asymptotic character of expansions and a constructive application in the region of strong coupling ($g >> 1$).

2792 (JINR-D—12831, pp 337-362) **Generalized kinetic equation for a dynamic system interacting with a phonon field.** Bogolyubov, N.N.; Bogolyubov, N.N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

The derivation of the kinetic equation proposed earlier is generalized. The methods for studying an electron-phonon system and for the exclusion of phonon operators from the corresponding kinetic equation are formulated. The kinetic equation for a polaron has been obtained for the electron-phonon field interaction. The exact Boltzmann equation for a polaron can be derived from this equation upon limiting by the corresponding approximation.

2793 (JINR-D—12831, pp 451-458) **Quantum mechanics and dynamics in phase space.** Zlatev, I.S. (Sofia Univ. (Bulgaria)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

Attention is paid to formal similarity of quantum mechanics and classical statistical physics. It is supposed that quantum mechanics can be reformulated by means of the quasiprobabilistic distributions (QPD). The procedure of finding a possible dynamics of representative points in a phase space is described. This procedure would lead to an equation of the Liouville type for the given QPD. It is shown that there is always a dynamics for which the phase volume is preserved and there is another dynamics for which the equations of motion are "canonical". It follows from the paper that in terms of the QPD the quantum mechanics is analogous to the classical statistical mechanics and it can be interpreted as statistics of phase points, their motion obeying the canonical equations. The difference consists in the fact that in the classical statistical physics constructed is statistics of points in a phase space which depict real, existing, observable states of the system under consideration. In the quantum mechanics constructed is statistics of points in a phase space which correspond to the "substrate" of quantum-mechanical objects which have no any physical sense and cannot be observed separately.

2794 (JINR-D—12831, pp 459-473) **Algebraic geometry and mathematical physics.** Novikov, S.P. (AN SSSR, Moscow. Inst. Teoreticheskoj Fiziki). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

The one-dimensional Korteweg-de Vries equation is studied. The method of the inverse problem is used for constructing periodic and quasiperiodic solutions of this equation. The stationary solutions of this equation are shown to be connected with the Riemann surface and to be quite an integrable hamiltonian system. The inverse problem method is generalized to some space-two-dimensional systems. Holomorphic stratifications over the Riemann surfaces are considered and exact solutions of the quasipotential equation are found.

2795 (JINR-D—12831, pp 512-531) **Asymptotic functions and their application in quantum theory.** Khristov, Kh.Ya.; Damyanov, B.P. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

An asymptotic function introduced as a limit for a certain class of successions has been determined. The basic properties of

the functions are given: continuity, differentiability, integrability. The fields of application of the asymptotic functions in the quantum field theory are presented. The shortcomings and potentialities of further development of the theory are enumerated.

2796 (JINR-D—12831, pp 274-290) **Summation of leading and non-leading infrared divergences in off-shell quantum electrodynamics.** Kaschluhn, F. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik; Akademie der Wissenschaften der DDR, Berlin-Zeuthen. Inst. fuer Hochenergiephysik). 1979. Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

The paper is aimed at showing that the remaining non-leading infrared divergence log contributions can be summed up completely and that the contributions modify the standard expressions only by a factor depending on the subtraction point. This result is achieved in two steps. First, it was employed a special eikonal approximation which takes into account the leading log contributions exactly and the non-leading log terms only partially. Secondly, the remaining non-leading log contributions are included for which multiplicative renormalization is used. The electron propagator S(p) and the vertex for zero momentum transfer are studied. They determine the infrared behaviour of Feynman diagrams. The eikonal approximation is formulated in such a manner that a scalar Ward identity holds exactly.

2797 **Index calculations for the fermion-vortex system.** Weinberg, E.J. (Department of Physics, Columbia University, New York, New York 10027). *Physical Review* [*Section*] *D: Particles and Fields;* **24**: No. 10, 2669-2673(15 Nov 1981).

A method is developed for calculating the index of first-order operators involving as background fields the scalar and vector fields of the two-dimensional Abelian Higgs model. The method is applied to the Dirac operator and shown to relate the number of fermion zero modes to the topology of the Higgs field.

2798 **Strong-coupling expansion for the ground-state energy in the 'x'/sup α/ potential.** Bender, C.M.; Mead, L.R.; Simmons, L.M. Jr. (Department of Physics, Washington University, St. Louis, Missouri 63130). *Physical Review* [*Section*] *D: Particles and Fields;* **24**: No. 10, 2674-2682(15 Nov 1981).

Using lattice techniques we examine the strong-coupling expansion for the ground-state energy of a g'x'/sup α/ (α>0) potential in quantum mechanics. We are particularly interested in studying the effectiveness of various Pade-type methods for extrapolating the lattice series back to the continuum. We have computed the lattice series out to 12th order for all α and we identify three regions. When α<2/3 the lattice series diverges faster than (2n)! and no extrapolation technique appears to work. When 2/3< or =α< or =2 the lattice series diverges roughly like Γ((2/α-1)n); here, diagonal Pade extrapolation schemes give excellent results. When α> or =2 the lattice series has a finite radius of convergence; here, completely-off-diagonal Pade extrapolants work best. As α increases beyond 2 it becomes more difficult to obtain good continuum results, apparently because the sign pattern of the lattice series seems to fluctuate randomly. The onset of randomness occurs earlier in the lattice series as α→∞.

2799 **Higher-order terms in the strong-coupling expansion for the renormalized effective potential.** Bender, C.M.; Cooper, F.; Guralnik, G.S.; Roskies, R.; Sharp, D.H. (Department of Physics, Washington University, St. Louis, Missouri 63130). *Physical Review* [*Section*] *D: Particles and Fields;* **24**: No. 10, 2683-2692(15 Nov 1981).

This is the third of three papers on the strong-coupling expansion of the renormalized effective potential in gphi^4 quantum field theory in d-dimensional Euclidean space-time. We first assume that the renormalized strong-coupling expansion for the coefficients of the effective potential in the continuum field theory is a series in powers of M/sup 4-d//g, where M is the renormalized mass and g is the bare coupling constant. The first term in this series was obtained in the previous paper. Here we estimate the next terms in the series. The results indicate that our assumption is unlikely to be true. Some alternatives are briefly discussed.

2800 **Fractional quantum numbers on solitons.** Goldstone, J.; Wilczek, F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review Letters;* **47**: No. 14, 986-989(5 Oct 1981).

A method is proposed to calculate quantum numbers on solitons in quantum field theory. The method is checked on previously known examples and, in a special model, by other methods. It is found, for example, that the fermion number on kinks in one dimension or on magnetic monopoles in three dimensions is, in general, a transcendental function of the coupling constant of the theories.

2801 **Observable fractional electric charge in broken quantum chromodynamics.** Slansky, R.; Goldman, T.; Shaw, G.L. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review Letters;* **47**: No. 13, 887-891(28 Sep 1981).

Quantum chromodynamics may be broken to SO/sub(3)/sup g/ with SU/sub(3)/sup c/ triplets becoming SO/sub(3)/sup g/ triplets. If so, there could exist low-mass, fractionally charged diquark states that are not strongly bound to nuclei, but are rarely produced at present accelerator facilities. The breaking of quantum chromodynamics can be done with a 27/sup c/, in which case this strong-interaction theory is easily embedded in unified models such as those based on SU(5), SO(10), or E(6). Possible relevance of diquarks for fusion catalysis is described.

2802 **Chromodynamics and the transverse momentum of jets and hadrons in e^+e^- annihilation.** Halzen, F.; Scott, D.M. (High Energy Physics Group, University of Hawaii, Honolulu, Hawaii 96822). *Annals of Physics (New York);* **135**: No. 1, 1-18(Aug 1981).

Transverse momentum distributions of jets and hadrons produced in high energy e^+e^- annihilation provide an arena in which to test perturbative QDC calculations. We present a phenomenological study of recent data obtained at PETRA in the context of such calculations. We urge the study of perturbative QCD on isolated samples of events with large transverse momemtum as lowest order results on momentums e.g., <p^2/sub T/>, are shown to be sensitive on the omission of higher orders.

2803 **Perturbative quantum chromodynamics (Tallahassee, 1981).** Duke, D.W.; Owens, J.F. (eds.). New York, NY; American Institute of Physics (1981). 486p. (CONF-810368—).

From Conference on perturbative quantum chromodynamics; Tallahassee, FL, USA (25 Mar 1981).

The Conference on Perturbative Quantum Chromodynamics was held on the Florida State University campus during March 25-28, 1981. The major goal of this conference was to provide an assessment of the status of our understanding of perturbative QCD. To this end, eight review talks were given during the morning sessions while the afternoons were devoted to shorter presentations of recent work. We feel that the talks contained in the proceedings offer a truly representative sample of the work being done on QCD using perturbative techniques.

2804 **DO Quark correlation functions exist in confining gauge theories.** Rothe, K.D.; Schroer, B. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Theoretische Physik). *Nuclear Physics* [*Section*] *B;* **172**: No. 2/3, 383-412(Sep 1980).

We investigate the long-range behaviour of gauge-dependent quark propagators in massive QED_2. On the basis of a simplified model abstracted from massibe QED_2 we find and exponential increase (non-temperedness) of the type exp(xi^{2}ln xi^2) for large distances. Thus the corresponding Fourier transform does not exist.

2805 **Higher twist effects in asymptotically free gauge theories. The anomalous dimensions of four-quark operators.** Okawa, M. (Tokyo Univ. (Japan). Dept. of Physics). *Nuclear Physics* [*Section*] *B;* **172**: No. 2/3, 481-508(Sep 1980).

The anomalous dimensions of the four-quark operators of twist four in the Wilson expansion are evaluated to second order in perturbation theory. The spinor calculus greatly simplifies the treatment of the fermion spin. The physical relevance of our results in deep inelastic scattering is discussed.

2806 Quantum chromodynamic black body radiation and the universe. Kiguchi, M. (Kyoto Univ. (Japan). Dept. of Physics). *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 146-159(Jan 1980).

The pressure of the black body radiation which consists of quarks, antiquarks and gluons is calculated by a perturbation method up to the third order of the gauge coupling constant g. It is found that the pressure obtained in this way becomes negative in the temperature below a few hundred MeV due to the plasma shielding effect. Using this result, a possible archaeology of the hadron era of the big bang universe is constructed, and the number ratio of the baryons to the photons is explained.

2807 Nachtmann moments of F /sub 2//sup νN/(x, Q²) and energy momentum sum rule. Okumura, M. (Kyoto Univ. (Japan). Dept. of Physics); Okumura, Y. *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 217-225(Jan 1980).

The Nachtmann moments of the singlet structure function F sub(2)sup(nu N) (x, Q^2) which contains the information of the mixing between quarks and gluons are predicted based on QCD in leading order approximations. The agreement with experimental data is fairly good. The energy momentum sum rule which is imposed on the Q^2-dependent quark and gluon distribution functions is not consistent with the Abelian vector gluon theory, but consistent with QCD. This fact concludes that the Abelian vector gluon theory with small fixed point is definitely excluded as the theory responsible for the strong interactions, whereas QCD is the most eligible one.

2808 Higher order effects of structure function moments. Haruyama, M. (Asahikawa Medical Coll., Hokkaido (Japan)); Kanazawa, A. *Progress of Theoretical Physics (Kyoto);* **63**: No. 1, 226-233(Jan 1980).

We investigate the Q^2-dependence of both the flavor non-singlet and the singlet Nachtmann moments of deep inelastic structure functions in the framework of QCD with full order-average g^2 corrections. The non-singlet moments-data are consistent with QCD as have been claimed so far. The order-average g^2 corrections are absorbed almost to the resetted value of scale parameter. However, there is a certain inconsistency among several approximation-schemes as will be discussed in detail. For the singlet moments the order-average g^2 corrections are shown to be very important to remove the discrepancy claimed recently by Duke and Roberts. We conclude that the QCD prediction for singlet moments is also not inconsistent with present experiments.

2809 Fermion asymmetry of the Universe and the W condensate. Krive, I.V. (Khar'kovskij Gosudarstvennyj Univ. (Ukrainian SSR)). *Yadernaya Fizika;* **31**: No. 5, 1259-1267(1980). (In Russian).

Possible appearance of a homogeneous condensate of charged W bosons in the quark-lepton matter is investigated in framework of various field models. It is shown for the Weinberg-Salam model, that at ratios of the baryonic charge to the leptonic charge in the matter, satisfying the inequality $B/L > 4/3$, and at some fermion density, the appearance of the W- condensate is preferable from the energetic point of view, while at the inverse condition $B/L < 4/3$ the W^+ condensate is preferable. In the limit of super-high densities the appearance of the W condensate results in the levelling of the partial densities of various kinds of leptons and quarks.

2810 Prolongation structure and inverse scattering formalism for supersymmetric sine-Gordon equation in ordinary space time variable. Chowdhury, A.R.; Roy, T. (Jadavpur Univ., Calcutta (India)). *Progress of Theoretical Physics (Kyoto);* **62**: No. 6, 1790-1791(Dec 1979).

2811 Pomeron and critical temperature, (3). Miyatake, Y. (Kyoto Univ. (Japan). School of Liberal Arts and Sciences). *Progress of Theoretical Physics (Kyoto);* **62**: No. 3, 837-839(Sep 1979).

6455 Scattering Theory

REFER ALSO TO CITATION(S) 2715, 2733, 2926

2812 Renormalization group sum rules for deep inelastic structure functions. Hirayama, M. (Toyama Univ. (Japan)); Kawabe, T. *Progress of Theoretical Physics (Kyoto);* **62**: No. 3, 835-836(Sep 1979).

65 PHYSICS RESEARCH

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 2927

2813 (IPNO—1979, pp T.1-T.57) **Theoretical physics division.** 1980. (In French). Dep. NTIS (US Sales Only).

In Annual report 1979.

Research activities of the theoretical physics division for 1979 are described. Short summaries are given of specific research work in the following fields: nuclear structure, nuclear reactions, intermediate energy physics, elementary particles.

6511 Experimental Techniques

2814 (INP—1014/PL, pp 823-839) **In beam electron and positron spectroscopy after heavy-ion collisions.** Backe, H. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Some new aspects of in beam spectroscopy of electrons and positrons after heavy ion collisions are discussed. The experimental set-up used is essentially an electron transport system with normal conducting solenoidal coils and a Si(Li)-detector as energy dispersive element. Spectroscopy of low energy conversion electrons emitted form recoil nuclei in flight after (HI,xn)-reactions is possible with a longitudinal semicylindrical baffle between target and Si(Li)-detector. Special features of this method are high transmission and strong suppression of the prompt delta-electron background. This method was applied for the investigation of a subnanosecond 12^+ isomer in the ^{188}Pt-nucleus by electron-gamma, electron-electron coincidence measurements as well as lifetime-measurements based on the detection of conversion electrons. The first observation of positron creation in 1.1 GeV ^{208}Pb+^{208}Pb collisions is reported. It is established that a dominant fraction of the positron yield is from none nuclear origins.

6512 Nuclear Properties And Reactions, A=1-5

2815 (INIS-mf—6542, pp vp) **Theory of large angle p-nucleus scattering? Pt. 1. pd elastic scattering and deuteron form factor at large q^2.** Gurvitz, S.A. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2816 (INIS-mf—6542, pp vp) **Asymptotic normalization of the chemical bond-tp, chemical bond-taun and tau-dp from charge form factor parametrization.** Moalem, A.; Rozenfeld, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2817 (KFTI—79-48, pp 34-35) **Charge form factors of three-particle nuclei in the translation-invariant oscillator basis.** Mikhelashvili, T.Ya. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Hadron electromagnetic interactions in the resonance energy range; Kharkov, Ukrainian SSR (30 May 1979).

Charge form factors of ^{3}H, ^{3}He and ^{12}C nuclei have been calculated by the method of translational-invariant oscillatory basis in the α-cluster model. The wave functions are found by diagonalization of the energy matrix of the corresponding nuclei. The Gogni-Peierls-De-Turreil potential is chosen for ^{3}H and ^{3}He nuclei. The local potential of Ali-Bodmer and the nonlocal separable potential of Mebonia and Surmava are used for a ^{12}C nucleus. The charge form factor of three-particle nuclei is presented in the form of a product of the three-particle systems nuclear form factor and the experimental charge form factor. The dependences of charge form factors of nuclei under investigation on the square of the transferred momentum γ^2 are presented. Charge form factors well agree with the experimental data obtained for the range of small values of q^2 at different values of the parameter $h/2\pi\omega$.

2818 **Elastic and inclusive analyzing power of deuterium for 0.8 GeV protons.** Brody, H.; Frankel, S.; Frati, W.; Van Dyck, O.B. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2157-2161(Nov 1981).

Measurements are reported of the analyzing power of deuterium for 0.8 GeV polarized protons covering the inclusive region up to and including elastic p-d scattering for both forward and backward emitted protons.

2819 **Measurement of deuteron-deuteron elastic scattering at 5.75 GeV/c.** Whipple, E.T.; Perez-Mendez, V.; Sagle, A.L.; Talaga, R.L.; Zarbakhsh, F.; Carroll, J.B.; Igo, G.J.; McClelland, J.B.; Bleszynski, M.; Ganezer, K. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **47**: No. 11, 774-777(14 Sep 1981).

The elastic differential cross section of 5.75-GeV/c deuterons scattered from deuterium has been measured over a range of $0.125<-t<2.0(GeV/c)^2$. The result shows a narrow interference minimum at $-t = 0.18$ $(GeV/c)^2$, but does not have a simple exponential behavior in the double-scattering region. The latter effect is attributed to constructive interference between the two double-scattering amplitudes, which have different t dependences. The results are compared to existing data and to a Glauber-model calculation.

2820 **Resonating group calculation for a three particle system.** Kumar, K. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.); Jain, A.K. (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). pp 124-126 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The elastic scattering of a projectile comprising of a loosely bound pair of particles by a target has been investigated in the Resonating Group Method (RGM). An effective interaction between the projectile and the target has also been derived in terms of the individual particle-target interaction. Phenomenological potentials are employed to describe, with reasonable accuracy, the antisymmetrized particle-target wavefunctions. This simplifies the analysis from an N-particle calculation to a three body RGM calculation. Results obtained for d-α scattering are compared with a full six nucleon calculation as well as with experiment. Results on ^{6}Li scattering on ^{40}Ca are discussed.

2821 **Target asymmetry and recoil nuclear polarization in photoproduction of pions and nuclear structure of ^{3}H and ^{3}He.** Ramachandran, G.; Keshavamurthy, R.S.; Murthy, M.V.N.; Venkatesh, K. (Mysore Univ. (India). Dept. of Physics). pp 135-137 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

In view of the availability of polarized ^{3}H and ^{3}He targets, it is now possible to study the target asymmetry experimentally. This, along with the recoil nuclear polarization provides a sensitive probe to the study of S', P and D state admixtures in the wave function of ^{3}H and ^{3}He. A systematic theoretical study of photoproduction of pions on the three body nuclei is presented and the study of these parameters experimentally is suggested.

2822 **Inelastic pion scattering on deuterons.** Keshavamurthy, R.S.; Ramachandran, G. (Mysore Univ. (India). Dept. of Physics). pp 140 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

2823 **Asymmetry in polarized electron deuteron inelastic scattering and neutrino disintegration of deuteron.** Singh, S.K. (Jiwaji Univ., Gwalior (India). School of Studies in Physics); Khan, S.A. (Aligarh Muslim Univ. (India). Dept. of Physics). pp 148-150 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The parity violating asymmetry in the electron-nucleon system is calculated in the polarised electron-deuteron inelastic scattering process esup(+-) + d $\rightarrow$ esup(+-)+n+p at the intermediate electron energies assuming closure approximation for the outgoing nucleons. Quantitative estimates are made for this asymmetry assuming Weinberg-Salam model for the weak neutral current Lagrangian and Hullthen wave function for the deuteron. The weak neutral disintegration of deuteron i.e. ν+d $\rightarrow$ ν+n+p at low neutrino energies relevant to the reactor antineutrinos as well as at the intermediate energies relevant to the experiments planned at LAMPF and Argonne has been studied. The total cross section for this process is calculated as a function of the neutrino energy assuming closure approximation for the outgoing nucleons and a Hulthen model for the deuteron.

2824 **Baryon resonance components in the deuteron and the back-angle proton-deuteron scattering at intermediate energies.** Jena, S. (Utkal Univ., Bhubaneswar (India). Dept. of Physics). pp 164-166 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The elastic proton-deuteron scattering cross sections at back angles have been calculated in the light of Kerman-Kisslinger model, using a generalised baryon transfer mechanism on the assumption that N's exist (with a probability approximately 1%) in the deuteron and that the backward peak is caused by their exchange. The effect of numerous competing open inelastic channels at intermediate energies on the elastic cross section is computed in a particularly simple model of Sopkovich. The resultant damping of the back scattering amplitude is expressed directly in terms of the forward angle elastic scattering data. The results are compared with the experimental cross sections in the energy range of 1.5 - 2.5 GeV.

6513 Nuclear Properties And Reactions, A=6-19

REFER ALSO TO CITATION(S) 2817, 2834, 2852

2825 (INIS-mf—6542, pp vp) **Linear response RPA calculations for ^{16}O and ^{18}O.** Moalem, A.; Bar-Touv, J. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2826 (INP—1014/PL, pp 167-220) **Microscopic approach to the description of the giant multipole resonances in light deformed nuclei.** Schmid, K.W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

A purely microscopic model for the description of the giant multipole resonances in light deformed nuclei and their excitation via proton radiative capture reactions is applied to study the $^{19}F(p,\gamma)^{20}Ne$ reaction. Cross sections as well as angular distributions are calculated taking into account the electric dipole as well as the electric quadrupole part of the electromagnetic interaction. Though quantitative agreement cannot be reached, the essential qualitative features of both the experimental cross sections and angular distributions are reasonably well reproduced. It is seen that the $^{19}F(p,\gamma)^{20}Ne$ reaction runs predominantly over the giant dipole states. The isoscalar giant quadrupole resonance is only weakly excited although intermediate states with large B(E2) values are available. This result may help to understand why inelastic α-scattering experiments on certain light nuclei do detect a rather different E2-strength distribution than the corresponding proton radiative capture experiments.

2827 **Structure of ^{18}Ne.** Nero, A.V.; Adelberger, E.G.; Dietrich, F.S. (Stanford University, Stanford, California 94305). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 1864-1883(Nov 1981).

We have studied ^{18}Ne states up to 9 MeV excitation energy via the $^{16}O(^3He,n)^{18}Ne$ and $^{20}Ne(p,t)^{18}Ne$ reactions. Excitation energies, widths, absolute cross sections, and angular distributions were measured. Distorted-wave Born-approximation calculations were performed for comparison with the (^{3}He,n) angular distributions and the (p,t) data were compared with previous calculations. Members of the 4.5-MeV doublet were found to have excitation energies of 4.518 +- 0.008 and 4.590 +- 0.008 MeV with spin and parity 1^- and 0^+, respectively. The 5.1-MeV group was resolved into a doublet with 5.090 +- 0.008 and 5.144 +- 0.008 MeV excitation energies. Several previously unidentified states were found at excitation energies greater than 5 MeV, including a state at 7.062 +- 0.012 MeV that is strongly populated via (^{3}He,n), but not observed in (p,t). We calculated two-particle Coulomb energy shifts for model mass-18 T = 1 states and found that the difference between the excitation energy of the 4.59-MeV 0^+ state and the analogous state at 5.34 MeV in ^{18}O gives strong evidence for the predominantly S^2/sub 1/2/ character of the state.

2828 **6.53 MeV state of ^8Li.** Arnold, L.G.; Boyd, R.N.; Ajzenberg-Selove, F.; Brown, R.E.; Flynn, E.R.; Sunier, J.W. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2326-2330(Nov 1981).

Results from a study of the $^9Be(t,\alpha)$ reaction with 17-MeV polarized tritons, as well as an analysis of earlier results, lead to an assignment of J/sup π/ = 4^+ for $^8Li^*(6.53)$.

2829 **^8Be nucleus geometric characteristics in the α-cluster model.** Pavlenko, O.P.; Steshenko, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). *Izvestiya Akademii Nauk, Seriya Fizicheskaya;* **43**: No. 11, 2389-2395(Nov 1979). (In Russian).

From 29. All-union conference on nuclear spectroscopy and nuclear structure; Riga, USSR (27 - 30 Mar 1979).

Presented are geometrical characteristics of a ^8Be nucleus calculated with the Brink-Booker and Volkov potentials in the translation-invariant model of shells (TIMS) and in the α-cluster model. The numerical results obtained make it possible to draw some conclusions on the shape of a ^8Be nucleus in the lowest rotational states. With complicating the model the root-mean-square radius and the effective nonsphericity for a particular potential grow, an increase in the effective nonsphericity being particularly considerable. The root-mean-square nuclear radius with increasing the distance between oscillatory wells depends only slightly on the deformation of the mean oscillatory field. The conclusions made earlier on the anomalous behaviour of geometrical characteristics of a ^8Be nucleus with increasing the angular momentum in the framework of TIMS with a deformed basis are valid for the α-cluster model as well.

2830 **Interpretation of structure of ^{18}O from comparative study of π^+ and π^- inelastic scattering.** Mahalanabis, J.; Choudhury, A. (Saha Inst. of Nuclear Physics, Calcutta (India)). pp 128-131 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The results of calculation for differential cross section for the excitation of the 2^+ and 3^- states in ^{18}O by π^+ and π^- scattering at 163 and 230 MeV energies are presented. The distorted wave calculations with local and non-local potential for both the states have been used. For the 2^+ state, the microscopic wavefunction of Lawson et al which is an admixture of shell model and collective states has been used. The results are compared with the recent data of SIN and LAMPF. There are characteristico differences for the π^+ and π^- results below and above the resonance energy. The results yield information of neutron distribution of the two extra-core valence neutrons.

2831 **Pion-nucleus absorption cross-section.** Bano, N.; Ahmad, I. (Aligarh Muslim Univ. (India). Dept. of Physics). pp 132-134 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

A fit to the π-^{12}C absorption cross-section data in the momentum range 0.71 to 2.0 GeV/c is obtained in the frame work of Glauber multiple scattering theory by varying the parameters of the π-N amplitude. The modified π-N amplitude so obtained is used to calculate π-^{40}Ca absorption cross section in the same energy range and a good agreement with experiment is obtained. Results so obtained demonstrate that the leading order corrections to the theory could be accounted for by varying the parameters of the π-N amplitude and hence, the analysis of the absorption cross section data for extracting information on the ground state structure of the target should use the effective π-N amplitude as determined from a fit to data on a nearby nucleus of reliably known ground state density.

2832 **Higher order tensor orientations of recoil nuclei in muon capture.** Subramanian, P.R.; Devanathan, V. (Madras Univ. (India). Dept. of Nuclear Physics). pp 145-147 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

For the experimental set-up of the Louvain Saclay Collaboration, general expressions are derived for all possible even and odd order tensor orientations of recoil nuclei, recoiling into the forward (or backward) hemisphere in the reaction μsup(-) + A(Jsub(i) = 0)→ B(Jsub(f) >= 1) + νsub(μ). It is shown that the odd order tensor orientations are proportional to the longitudinal polarization and the even order tensor orientations are proportional to a linear combination of longitudinal and average polarizations of the recoil nucleus. These results are independent of nuclear structure and the dynamics of the muon capture interaction. Numerical results are presented for the case of muon capture by ^{16}O.

2833 **Study of some weak and electromagnetic processes in ^6Li.** Ahmad, I. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire); Singh, S.K. (Jiwaji Univ., Gwalior (India). School of Studies in Physics). pp 151 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 2852, 2901

2834 (INP—1014/PL, pp 123-135) **Evidence for systematical features in proton elastic scattering related to nuclear structure.** Colombo, E.; De Leo, R.; Escudie, J.L.; Fabrici, E.; Micheletti, S.; Pignanelli, M.; Resmini, F.; Tarrats, A. (Milan Univ. (Italy). Ist. di Fisica; Istituto Nazionale di Fisica Nucleare, Milan (Italy)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The elastic scattering cross sections have been measured for nuclei in the mass region A = 9 to 64. The phase shift analysis of angular distributions was performed.

2835 **Alpha-particle emission from the fusion of ^{32}S with ^{27}Al.** Berkowitz, G.; Braun-Munzinger, P.; Harris, J.W.; Jachcinski, C.; Barrette, J. (Department of Physics, State University of New York, Stony Brook, New York 11794). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2030-2034(Nov 1981).

Alpha particles produced in the fusion of ^{32}S with ^{27}Al at E/sub lab/ = 160 MeV were observed at θ/sub lab/ = 15°, 40°, 45°, 75°, 130°, and 160° in coincidence with evaporation residues detected at θ/sub lab/ = -5.8° using a time-of-flight spectrometer. The data were compared to a simple Monte Carlo calculation based on the statistical evaporation of light particles from an equilibrated compound nucleus. The total coincidence energy spectra show no evidence of preequilibrium emission of alpha particles.

2836 **Fusion of ^{24}Mg+^{24}Mg.** Jachcinski, C.M.; Kovar, D.G.; Betts, R.R.; Davids, C.N.; Geesaman, D.F.; Olmer, C.; Paul, M.; Sanders, S.J.; Yntema, J.L. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2070-2075(Nov 1981).

Total fusion cross sections for ^{24}Mg+^{24}Mg have been measured in the energy range from 24.7 < or =E/sub c.m/< or =66.2 MeV by the detection of evaporation residues, either directly in a ΔE-E telescope, or by measurement of prompt γ-ray activity. The excitation functions for the individual reaction channels, and the total fusion cross sections show relatively smooth behavior with no evidence for oscillatory structure of magnitude greater than 5%. The parameters obtained by fitting the data with a 1/E/sub c.m./ energy dependence are somewhat different from those expected from the systematics of fusion reactions in the high-energy region.

2837 **Direct transfer reaction induced by 100 MeV ^{18}C beam on ^{27}Al target nuclei.** Mermaz, M.C.; Barrette, J.; Wegner, H.E. (Departement, de Physique Nucleaire, Centre d'Etudes Nucleaires de Saclay, BP 2, 91190 Gif-sur-Yvette, France). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2148-2156(Nov 1981).

Nuclei in the range 3< or =Z< or =9 produced by direct transfer reactions induced by 100 MeV ^{18}O ions on ^{27}Al have been studied between θ/sub lab/ = 6° and 50°. Few-nucleon-transfer reactions populating continuum states exhibit a strong quasielastic behavior and can be described by an extension of the diffraction model for inelastic process. On the other hand, heavier-mass-transfer reactions are damped in energy and present the usual characteristics of deep inelastic collisions.

2838 **Variety of information inherent in nuclear (p,2p) reaction analyses.** Amos, K. (Melbourne Univ., Parkville (Australia). School of Physics). pp 4.1.1-4.1.19 of Molecular physics and quantum chemistry: into the 80's. Burton, P.G. (ed.). Wollonong, Australia; University of Wollongong (1980).

From Molecular physics and quantum chemistry workshop; Wollongong, Australia (11 Feb 1980).

Nuclear reaction theory for (p,2p) reactions is reviewed in general to show how and what type of information about nuclear spectroscopy and nuclear reaction mechanisms (the two nucleon t-matrix in particular) is inherent in reaction data. The results of various model calculations are shown to illustrate what information has been and what information might yet be extracted from pertinent anlayses of appropriate data.

2839 **Optical model dependence of the reaction ^{24}Mg(^{16}O,^{12}C)^{28}Si.** Hasan, H. (Poona Univ. (India). Dept. of Physics). pp 167-169 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

An attempt is made to understand the dependence of angular distributions for α-transfer reactions between heavy ions on the optical potential, using semiclassical concepts. Angular distributions are calculated semi-classically for the reaction ^{24}Mg(^{16}O,^{12}C)^{28}Si at 56 MeV and 48 MeV laboratory energies using two different optical potentials. The l-dependence of the partial wave amplitudes is examined in each case. An interesting by-product of the calculation is that the probability of transfer is maximum for the separation of the interacting nuclei greater than the 'grazing distance' by the order of the α-particle radius.

6515 Nuclear Properties And Reactions, A=39-58

REFER ALSO TO CITATION(S) 2820, 2831, 2834, 2872

2840 (IA—1356, pp 169-170) **Study of the ^{49}Ti energy levels using the (γ,γ') and (γ,n) reactions.** Berant, Z.; Birenbaum, Y.; Shahal, O.; Moreh, R. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2841 (INP—1014/PL, pp 308-362) **Back-angle anomalies and molecular resonances phenomena in heavy-ion collisions.** Eberhard, K.A. (Muenchen Univ. (Germany, F.R.). Sektion Physik). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

This lecture will cover two main topics, which have been of particular interest to heavy-ion physicists during the last few years. First I will try to review the experimental situation on the so-called anomalous large-angle scattering (ALAS). This will include recent high-precision data for the scattering of lithium and oxygen projectiles. Theoretically, the recent success of a squared Woods-Saxon formfactor to reproduce α+sup(40,44)Ca scattering at all energies, where data are available, will be reported. In the second part of this lecture we will discuss some of the existing evidence for molecular resonance phenomena.

2842 (INP—1014/PL, pp 431-460) **Gamma-ray spectroscopy in medium-light nuclei.** Sharpey-Schafer, J.F. (Liverpool Univ. (UK). Oliver Lodge Lab.). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Gamma ray spectroscopy of some nuclei in the mass region A=40 is performed. Positions and spins of some levels are found. The shell model calculations of level positions are presented.

2843 (INP—1014/PL, pp 461-476) **High-spin neutron particle-hole states in even N = 28 isotones.** Styczen, J. (Institute of Nuclear Physics, Krakow (Poland)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The energy levels of ^{50}Ti, ^{52}Cr and ^{54}Fe have been studied by means of gamma spectroscopy. Experimental evidence is presented that there exist in these nuclei levels with spins exceeding the maximum angular momenta allowed by the (fsub(s)7/2)sup(n) shell. Calculations allowing configurations with higher orbit than fp shell are able to account for the observed level schemes and decay properties.

2844 **Photon scattering studies of the giant dipole resonance in medium weight nuclei.** Bowles, T.J.; Holt, R.J.; Jackson, H.E.; Laszewski, R.M.; McKeown, R.D.; Nathan, A.M.; Specht, J.R. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 1940-1951(Nov 1981).

Quasimonochromatic photons have been used to measure elastic and inelastic photon scattering cross sections in the giant dipole resonance region of ^{52}Cr, Fe, ^{60}Ni, ^{92}Mo, and ^{96}Mo in an experiment in which the elastic and inelastic scattering are resolved. The elastic scattering cross sections show clear evidence for isospin splitting of the giant dipole resonance. The inelastic scattering to low-lying vibrational levels, which is a measure of the coupling between the giant dipole resonance and collective surface vibrations, is in qualitative agreement with the predictions of the dynamic collective model. However, when examined in detail, this model does not provide an adequate description of the scattering data.

2845 **Determination of the spin-orbit interaction for neutron-nucleus scattering.** Floyd, C.E.; Guss, P.P.; Murphy, K.; Byrd, R.C.; Tungate, G.; Wender, S.A.; Walter, R.L.; Clegg, T.B. (Department of Physics, Duke University, Durham, North Carolina 27706). *Physical Review Letters;* **47**: No. 15, 1042-1045(12 Oct 1981).

Accurate analyzing power data have been obtained for scattering of 10- and 14-MeV neutrons from ^{54}Fe and ^{65}Cu with use of a new combination of techniques to produce pulsed, polarized neutron beams. Parametrization with the conventional optical model yields a spin-orbit interaction which is consistent with that observed for proton-nucleus scattering. This combined experimental and theoretical study represents the most sensitive test of similarities between proton and neutron spin-orbit potentials for medium-weight nuclei.

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 2844, 2844, 2845, 2856

2846 (INIS-mf—6542, pp vp) **Resonant scattering of gamma rays from ^{62}Ni in Mg_2Ni, Mg_2NiH_4 and Mg_2NiD_4.** Jacob, I.; Mintz, M.H.; Shahal, O.; Wolf, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2847 (INP—1014/PL, pp 412-430) **Nature of the O^+ levels and shape transitions in the Ge and Pt regions.** Vergnes, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The article is devoted to shape transitions and to the correlated subject of the O^+ levels in the Ge and Pt regions. The experiments concerning the Ge region as well as the possible interpretations of the results are discussed. Also the results touching the Pt region are quoted and interpreted.

2848 **Statistical properties of complex states of ^{67}aXZn.** Garg, J.B.; Tikku, V.K.; Harvey, J.A.; Macklin, R.L.; Halperin, J. (State University of New York, Albany, New York 12222). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 1922-1939(Nov 1981).

High resolution neutron total and capture cross section measurements have been made on the separated isotope ^{66}Zn in the energy range from a few keV to about 1 MeV using the neutron time-of-flight technique and the pulsed Oak Ridge Electron Linear Accelerator. The nominal resolution of the measurements was 0.07 ns/m. The total cross section data have been analyzed up to 380 keV using a multilevel R-matrix formalism and the capture data up to 130 keV using a least squares fit program. From these analyses we have obtained the values of the resonance parameters E_o, $g\Gamma_n$, and Γ_γ, and values of average quantities: $D_l = 0 = (4.62 \pm 0.55)$ keV, $D_l = 1 = (1.17 \pm 0.14)$ keV, $S_0 = (2.06 \pm 0.36)$, $S_1 = (0.66 \pm 0.06)$, and $S_2 = (0.50 \pm 0.12)$ in units of 10^{-4} eV$^{-1/2}$. The values of average radiation widths are (0.39 ± 0.06) eV for s-wave resonances and (0.190 ± 0.013) eV for p-wave resonances. The distributions of neutron reduced widths and of level spacings of s- and p-wave resonances show excellent agreement with the Porter-Thomas and Wigner distributions, respectively. The value of the Δ_3 statistic for the long range correlation of s-wave energy levels is found to be in reasonable agreement with the theoretical prediction of Dyson and Mehta. A value of 0.59 ± 0.10 has been determined for the linear coefficient for the correlation between the neutron reduced widths and the radiation widths of 26 s-wave resonances. This value is highly significant and has a confidence level of 99.7%.

2849 **Fast protons and alpha particles from the $^{12}C+^{60}Ni$ reaction.** Robinson, R.L.; Auble, R.L.; Lee, I.Y.; Martin, M.J.; Young, G.R.; del Campo, J.G.; Ball, J.B.; Bertrand, F.E.; Ferguson, R.L.; Fulmer, C.B.; Wu, J.R.; Wells, J.C.; Yamada, H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2084-2101(Nov 1981).

The emission of energetic light ions from heavy-ion induced reactions was studied by measuring coincidences of protons and alpha particles with (1) Z = 1 to 7 particles, (2) discrete γ rays, and (3) γ-ray multiplicities from bombardment of ^{60}Ni with ^{12}C ions. Incident beam energies were 136 and 194 MeV. Discrete γ rays were used to identify the residual target-like fragments. Most of the particle-particle coincident angular correlations are strongly peaked in the forward direction; the full width of half maximum of the proton distributions are typically 50°, those of the alpha particles are 30°. The N-Z distributions of the residual nuclei peak around ^{60}Ni. The γ-ray multiplicities are insensitive to the energy of the gating energetic light ion and are about 9 for 136-MeV ^{12}C projectiles and 10 for 194 MeV. The results indicate the contribution of more than one mechanism in producing the high-energy light ions. In part the energetic light ions are emitted in association with a projectilelike fragment. A major component of the energetic light ions can be explained as emission from the projectilelike fragment during the collision process followed by fusion of the remainder of the fragment with the target.

2850 **Momentum transfer in the fragmentation of Cu by relativistic heavy ions and protons.** Cumming, J.B.; Haustein, P.E.; Hseuh, H. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2162-2173(Nov 1981).

Mean kinetic properties of selected products from the fragmentation of Cu by ^{1}H, ^{4}He, and ^{12}C ions over energies ranging from 0.18 to 28 GeV/nucleon have been determined by the thick-target, thick-catcher technique. Momentum transfer, as inferred from F/B ratios, is observed to occur most efficiently for the lower velocity projectiles. Recoil properties of the target fragments, analyzed using the two step velocity vector model, vary strongly with product mass. Rapidity (or some other velocity related parameter) is the dominant projectile variable which governs momentum transfers to fragments from Cu. This and previous observations of the importance of kinetic energy in determining fragment yields are shown to be consistent with a simple kinematical model for the fragmentation process. Major deviations from such simple behavior are observed for high-energy heavy ions incident on heavy elements targets.

2851 **Comment on isospin and strong-coupling effects in neutron scattering from even-A Se isotopes.** Brown, V.R.; Wong, C.; Grimes, S.M.; Poppe, C.H.; Madsen, V.A. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2359-2362(Nov 1981).

The effect of coupling of the two-phonon states on elastic and 2^+ inelastic cross sections is calculated for 8 MeV neutrons incident on /sup 76,80,82/Se. Isospin optical parameters and deformation parameters are determined from comparison with data. The values of β are larger than one would expect on the basis of measured values form (p,p') and Coulomb excitation.

2852 **Elastic scattering total cross-sections of electrons in the energy range 1.2 to 3 MeV.** Balladore, J.L.; Martinez, J.P.; Jouffrey, B.; Trinquier, J.; Verdier, P. (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Optique Electronique). *Journal de Microscopie et de Spectroscopie Electroniques;* **5**: No. 3, 323-331(Jun 1980). (In French).

The study of image contrast in electron microscopy requires a knowledge of the elastic scattering cross-sections and electron

scattering factors. We determine these parameters for various elements and for electron energies ranging from 1.2 to 3 MeV. We compare these results with those found in the literature, and examine the influence of the form of the screening term in the atomic potential.

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 2844, 2852, 2904, 2914, 2918

2853 (IA—1356, pp 173-174) **Nuclear structure studies of ^{143,145}Ba.** Rapaport, M.S.; Gayer, A. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2854 (INIS-mf—6542, pp vp) **De-excitation modes of low lying level in ^{128}I from the ^{128}Te(p,γ)^{128}I reaction.** Burde, J.; Richter, V.; Labaton, I. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics); Moalem, A. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2855 (INIS-mf—6542, pp vp) **Nuclear anti-stokes transitions induced by laser radiation.** Arad, B.; Eliezer, S.; Paiss, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2856 (INIS-mf—6542, pp vp) **Magnetic moments in nuclei near closed shell? The 2_1^+ levels in even Zr and Sn isotopes.** Hass, M.; Broude, C.; Niv, Y.; Zemel, A. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2857 (INIS-mf—6542, pp vp) **g factor of the first excited 2^+ state in ^{100}Zr.** Wolf, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev); Battistuzzi, G.; Kawade, K.; Lawin, H.; Sistemich, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2858 (INP—1014/PL, pp 859-877) **Investigation of quasi-molecular in heavy ion collisions quasi-molecular Roentgen radiation.** Kaun, K.H. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

There is done a review of the present status of experimental studies of the transitient formation of quasi molecules in the heavy ion collisions and the quasi molecular X-ray emission.

2859 (INP—1014/PL, pp 276-307) **Angular momentum in heavy-ion reactions.** Oeschler, H. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Three problems of heavy ions reactions are investigated: elastic scattering in the presence of Coulomb excitation, transfer reactions, and compound nucleus with high angular momenta production. Analysis of these problems is performed taking into account angular momentum transfer dependence of reaction mechanism.

2860 (INP—1014/PL, pp 25-42) **Experimental work on high spin isomers and possible yrast traps.** Sletten, G. 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The purpose of this work was finding the high spin isomeric nuclei decaying with delayed γ-ray cascades with high multiplicity. Pulsed beam of ^{40}Ar, ^{50}Ti and ^{65}Cu of energy 230 MeV with various target was used. For gamma cascades detection system of 16 NaI detectors was used. There were found some high spin isomers in region 64<=Z<=71 and 82<=N<=88.

2861 (INP—1014/PL, pp 114-117) **Study of high spin isometric states in multiplicity experiments with ^{12}C induced reactions.** Hageman, D. (Kernfysiskh Versneller Instituut, Groningen, Netherlands). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

System of detectors for γ-γ coincidence spectroscopy is presented. System consists of 16 NaI detectors and one Ge(Li) detector. This allows to measure multiple coincidence of gamma quanta.

2862 (INP—1014/PL, pp 136-166) **^{6}Li induced reactions well above the Coulomb barrier.** Jastrzebski, J. (Institute of Nuclear Research, Warsaw (Poland)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The experimental investigations of the mechanism of reactions induced by ^{6}Li ions are much less numerous for energies exceeding 10 MeV/nucleon than for lighter or slightly heavier projectiles. It was only quite recently that these reactions were investigated in the 50 - 150 MeV energy range. It is well known that for lower energies and especially in the vicinity of the Coulomb barrier the loosely bound d-structure of this projectile affects strongly the transfer probability of ^{6}Li "components". We shall try to answer the question: does this structure influence also the reaction pattern for bombarding energies exceeding many times the Coulomb barrier.

2863 (INP—1014/PL, pp 381-411) **In beam gamma ray spectroscopy with 100-160 MeV α's in medium light nuclei.** Signorini, C. (Padua Univ. (Italy). Ist. di Fisica). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The total cross sections of alpha reactions with nuclei of the 1 f 7/2 shell are measured. For measurements γ-ray in beam spectroscopy was used. The results are compared with reactions induced by other particles: π, K,p and heavy ions.

2864 (INP—1014/PL, pp 477-481) **In-beam investigation of the N = 82 nucleus ^{143}Pm.** Stary, F.; Prade, H.; Kaeubler, L.; Hagemann, U.; Jareger, H.U.; Kirchbach, M.; Schneider, L. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The ^{143}Pm levels were investigated using on-line gamma spectroscopy with linear polarization measurements. For a few levels spin and parity was determined. Experimental results are compared with shell model calculations. ^{143}Pm nuclei was obtained from (α, 2n) and (d, 2n) reactions.

2865 (INP—1014/PL, pp 533-550) **Line alpha spectroscopy on 1 GeV proton beam from synchrocyclotron.** Kormicki, J. (Joint Inst. for Nuclear Research, Dubna (USSR); Institute of Nuclear Physics, Krakow (Poland)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The alpha decay on short living nuclei lying above closed neutron shell with N=82 was investigated. Decaying isotopes were obtained using 1 GeV proton beam. The lifetimes of some nuclei were measured.

2866 (INP—1014/PL, pp 841-858) **Experiments on K-hole and positron production in collisions of very heavy ions.** Bokemeyer, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The collision of very heavy nuclei at energies around the Coulomb-barrier opens not only a chance of enlarging our knowledge on nuclear physics but also gives rise to some quantum-electrodynamic processes which occur because of the deep and strongly time-varying Coulumb-field of the two colliding nuclei with $Z_A+Z_B >> 137$.

2867 **Basic concepts in the description of collisions between heavy nuclei. Chapter 1.** Noerenberg, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). pp 1-43 of Heavy ion collisions. Volume 2. Bock, R. (ed.) (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Amsterdam, Netherlands; North-Holland (1980).

Some basic concepts are introduced which are frequently used for describing heavy ion collisions. The discussion is mainly concerned with collisions between heavy nuclei with energies well above the Coulomb barrier, such that the wavelength of relative motion is small as compared to the characteristic lengths of the interaction potential. Therefore, these collisions can frequently be treated in the classical limit. The authors discuss qualitatively the different classes of heavy ion collisions and consider the reaction cross section in some detail. The classical theory of elastic scattering is described and gross properties of heavy ion reactions like Q-values, driving potentials, compound-nucleus formation and heavy ion interaction potentials, are considered.

2868 **Results of deep-interactions between complex nuclei - complete and incomplete fusion. Chapter 2.** Lefort, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). pp 45-126 of Heavy ion collisions. Volume 2. Bock, R. (ed.) (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Amsterdam, Netherlands; North-Holland (1980).

Experiments are described in which compound nuclei are formed without any ambiguity. The criteria for determining a true complete fusion by its effects on the observed products, are discussed. The experimental aspects of the limitations on compound nucleus formation, its dependence on the projectile mass, on the kinetic energy and on the orbital angular momentum in the entrance channel, are dealt with. The concept of critical angular momentum for complete fusion, its origins and its theoretical approaches are briefly discussed. The new concept of critical distance is developed. Experimental results of heavy ion reactions are presented which show that some fusion process has occurred, that a large part of the energy has been relaxed, but however, the composite system shortly moves toward a scission of two components. The status of the present knowledge of the influence of nuclear matter viscosity on fusion is considered.

2869 **Dissipative collisions. Chapter 3.** Gobbi, A.; Noerenberg, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). pp 128-273 of Heavy ion collisions. Volume 2. Bock, R. (ed.) (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Amsterdam, Netherlands; North-Holland (1980).

Experimental techniques and results for dissipative collisions are reported. The observed relaxation phenomena are analysed in terms of Fokker-Planck equations. The derivation and application of microscopic transport theories is considered. The main features of dissipative collisions are summarised and future developments indicated.

2870 **Fusion and fission of heavy nuclei. Chapter 4.** Mosel, U. (Giessen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). pp 275-357 of Heavy ion collisions. Volume 2. Bock, R. (ed.) (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Amsterdam, Netherlands; North-Holland (1980).

The theories used to calculate the potential energy surface and the mass parameters are reviewed. For nuclear fission the theoretical data can be quantitatively compared with experimental data, but of heavy ion interactions a quantitative theory is still missing. Damping of collective motion by the concept of nuclear viscosity is discussed and its consequences for fission and fusion described. The structure of compound nuclei at high excitation energies as they are being formed in a heavy ion reaction is discussed. The close relationship between fission and heavy ion processes is stressed by using formalisms for the description of the latter that originated in fission theory.

2871 **Lowlying even parity states in odd proton nuclei with Z = 55 - 63.** Seo, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Aoki, K. *Annual Reports of the Research Reactor Institute, Kyoto University;* **12**: 156-160(Nov 1979).

2872 **Resonances and resonance-like structures in spherical nuclei.** Vdovin, A.I. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Izvestiya Akademii Nauk, Seriya Fizicheskaya;* **43**: No. 10, 2018-2032(Oct 1979). (In Russian).

From 29. All-union conference on nuclear spectroscopy and nuclear structure; Riga, USSR (27 - 30 Mar 1979).

The latest experimental and theoretical data on resonances and resonance-like structures in ^{12}C, ^{16}O, ^{208}Pb, ^{90}Zr spherical nuclei at intermediate excitation energies have been reviewed. The low-lying E3-and H2-resonances, the structures connected with excitation of low-lying hole states are discussed. A comparison of the recent experimental data with predictions of theoretical models shows that the models describe quite satisfactorily not only the qualitative but in some cases quantitative side of the experiment. The interaction with complex configurations is very important, its account being necessary for obtaining correct quantitative results. The quasiparticle-phonon model of a nucleus allows one to describe a rather large amount of diversified experimental results using a unified set of parameters, and that permits to expect good results on still noninvestigated characteristics of nuclear excitations at intermediate energies.

2873 **Finite range effect in deuteron stripping reaction using realistic forces.** Kidwai, H.R. (Saint Stephen's Coll., Delhi (India)). pp 121-123 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

An attempt is made to calculate the finite range effect in the DWBA theory for the A(d,p)B reaction using a realistic potential for the deuteron. Both S and D states are taken into consideration and a method is used to treat the hard core in the N-N interaction. The effect is shown to be energy and angle dependent and a comparison is made with previous results.

2874 **Isospin dependence of optical potential for neutrons at 14 MeV.** Satyanarayana, U.; Ramamurty, S. (Andhra Univ., Waltair (India). Lab. for Nuclear Research). pp 127 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

2875 **Correction to impulse approximation in pion-nucleus potential.** Phatak, S.C. (Institute of Physics, Bhubaneswar (India)). pp 141-144 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The local density approximation is used to estimate the effects of correction to the impulse approximation in the first order pion-nucleus optical potential. The calculation indicates that at low pion kinetic energies (approximately or $<$ 100 MeV), the correction changes the potential considerably and weakens both the real and imaginary parts. Even in the resonance region (pion kinetic energy approximately 200 MeV) the effects of this correction are large in the nuclear interior, although in the nuclear surface region these effects could be neglected.

2876 **Delayed proton emission from neutron deficient nuclei.** Rao, B.M.; Narayana, D.G.S.; Rao, P.M.; Rao, L.R.; Rao, M.S.; Rao, V.S.; Sastry, D.L. (Andhra Univ., Waltair (India). Lab. for Nuclear Research). pp 224 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

2877 **Inside story of α-decay: the rare earth α-emitters.** Basu, M.K. (University Coll. of Science, Calcutta (India). Dept. of Physics). pp 227 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 2860, 2871, 2877, 2885

2878 (INIS-mf—6160, pp vp) **Isotope distribution of indium producing at interaction of protons (0.66 and 8 GeV) and deuterons (8 GeV) with Ta and W.** Avdeev, S.P.; Karnaukhov, V.A.; Kuznetsov, V.D.; Nad, T.; Petrov, L.A. 1980. (In Russian). Dep. NTIS (US Sales Only).

From 30. conference on nuclear spectroscopy and nuclear structure; Leningrad, USSR (18 Mar 1980).

2879 (INP—1014/PL, pp 118-119) **High-spin states in the ground-state and side-bands in ^{156}Dy, ^{162}Er and ^{168}Hf investigated through proton-and ^{14}N-induced reactions.** Vervier, J. (Institut de Physique Corpusculair, Louvain-La-Neuve, Belgium). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Ground-state and side-bands in the nuclei ^{156}Dy, ^{162}Er and ^{168}Hf have been investigated using proton and ^{14}N beams. The gamma deexcitation spectra have been measured on line. The use of proton beam allowed also to populate non-yrast levels with measurable intensities for their gamma decays.

2880 (INP—1014/PL, pp 482-489) **Shape transition in the odd Tb nuclei.** Will, E.; Winter, G.; Kemnitz, P.; Doering, J.; Funke, L. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)); Elfstroem, S.; Hjorth, S.A.; Johnson, A.; Lindblad, Th. (Research Institute of Physics, Stockholm, Sweden). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Gamma ray deexcitation spectra of ^{153}Tb and ^{151}Tb excited in (α, xn) reaction were measured. Experimental level scheme is compared with shell model calculations results.

2881 **Neutron emission in ^{12}C+^{158}Gd and ^{13}C+^{157}Gd reactions between 8 and 12 MeV/nucleon.** Gavron, G.; Beene, J.R.; Ferguson, R.L.; Obenshain, F.E.; Plasil, F.; Young, G.R.; Petitt, G.A.; Young, K.G.; Jaeaeskelaeinen, M.; Sarantites, D.G.; Maguire, C.F. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2048-2069(Nov 1981).

Neutron spectra in coincidence with evaporation residues and with projectilelike fragments emitted in inelastic scattering reactions have been measured at several bombarding energies for ^{12}C- and ^{13}C-induced reactions leading to the same compound nucleus ^{170}Yb. In the fusion reactions, a nonequilibrium component was observed in the neutron spectra at all beam energies. This component is forward peaked and is associated with a high temperature. The spectra can be parametrized by assuming the nonequilibrium part to result from a hot region (T~4 MeV) emitting neutrons isotropically and moving with a velocity of approximately 1 cm/ns. This apparent velocity decreases with decreasing beam velocity. Comparisons are made with predictions based on the generalized critical angular momentum model of incomplete fusion of Siwek-Wilczynska et al. No significant difference has been observed between nonequilibrium neutron emission from ^{12}C- and ^{13}C-induced reactions. Neutron emission associated with inelastic scattering reactions cannot be described by simple statistical evaporation from two fragments of equal temperature. Effects which may give rise to the observed energy and angular distributions of neutrons in coincidence with inelastic products are discussed.

2882 **Feeding of high-spin particle yrast states by collective structures in the continuum.** Chowdhury, P.; Borggreen, J.; Khoo, T.L.; Ahmad, I.; Smither, R.K.; Faber, S.R.; Daly, P.J.; Dors, C.L.; Wilson, J. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **47**: No. 11, 778-781(14 Sep 1981).

The population of yrast states in ^{152}Dy and properties of continuum γ rays have been measured as a function of input angular momentum, l, via the ^{122}Sn(^{34}S,4n) reaction. With increasing l an eventual saturation of the high-spin population with a narrow region of yrast feeding is observed, together with an enhanced yield in the continuum spectra. This implies that the decay of very-high—spin states is diverted from the yrast line by continuum cascades and suggests collective modes which might be built on high-J particle states.

2883 **Spectrum and static moments of ^{187}Re.** Mittal, R.; Sharma, S.D.; Sahota, H.S.; Sehgal, V.K. (Punjabi Univ., Patiala (India). Dept. of Physics). pp 221-222 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The spectrum and static moments of ^{187}Re are calculated using extension of Davydov-Filippov model. The Hamiltonian including the coriolis coupling term is used to calculate the effective moment of inertia for various bands. The kinking effect in the excited bands is studied by mixing the pair of bands such that both bands in single pair have same k value either k = 1/2 or 3/2. The effective moment of inertia under excitation is found to change with spin. The change is found in agreement with the theoretical prediction on the basis of this model.

6519 Nuclear Properties And Reactions, A=190-219

REFER ALSO TO CITATION(S) 2847, 2852

2884 (INIS-mf—6542, pp vp) **Study of interference between giant resonances via ^{206,207}Pb(γ,n) reaction.** Birenbaum, Y.; Berant, Z.; Kahane, S.; Moreh, R.; Wolf, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2885 (INP—1014/PL, pp 683-686) **Shape of platinum nuclei around A = 190.** Doenau, F. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The shape of platinum isotopes is considered. Microscopic calculations of the potential energy surface contradict suggestions that these nuclei should be triaxial. The proof of resolving of the platinum isotopes structure using results of Coulomb excitation is made.

2886 **^{206}Pb+n resonances for E = 600 —900 keV: Neutron strength functions.** Horen, D.J.; Harvey, J.A.; Hill, N.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 1961-1968(Nov 1981).

Data from high resolution neutron transmission and differential scattering measurements performed on ^{206}Pb have been analyzed for E = 600 —900 keV. Resonance parameters (i.e., E, l, J, and Γ/sub n/) have been deduced for many of the 161 resonances

observed. Strength functions and potential phase shifts for s-, p-, and d-wave neutrons for E/sub n/ = 0 —900 keV are compared with optical model calculations. It is found that the phase contributed by the external R function as well as the integrated neutron strength functions can be reproduced for the s and d waves with a well depth of V_0 = 50.4 MeV for the real potential and W/sub D/ = 6.0 MeV for an imaginary surface potential. Somewhat smaller values (V_0 = 48.7 MeV and W/sub D/ = 2.0 MeV) are required to reproduce the p-wave data. These values of the real potential are also found to give the experimentally observed binding energies for the 4s/sub 1/2/, 3d/sub 3/2/, and 3d/sub 5/2/ single particle levels (V_0 = 50.4 MeV), and the 3p/sub 1/2/ single particle level (V_0 = 48.7 MeV). Nuclear level densities for s and d waves are found to be well represented by a constant temperature model. However, the model under estimates the number of p-wave resonances.

2887 **Spectroscopy of /sup 204,206,208/Rn and the systematic behavior of Z = 86 isotopes.** Horn, D.; Baktash, C.; Lister, C.J. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2136-2147(Nov 1981).

A spectroscopic investigation of the radon isotopes /sup 204,206,208/Rn was performed by means of the reactions /sup 192,194,196/Pt(^{16}O, 4n)/sup 204,206,208/Rn and ^{197}Au(^{14}N,5n)^{206}Rn with ^{16}O energies between 85 and 110 MeV and ^{14}N energies between 80 and 94 MeV. γ-γ coincidences, pulsed beam yield functions, angular distributions, and pulsed beam isomeric decay rates were measured. The yrast and near-yrast level structure was established to J∼15h, and in each of the three nuclei two isomers above the known J = 8$^+$ state were observed. The systematic trends for the Z = 86 isotopes are compared with the behavior expected in a single particle mode, and increased collectivity is found with decreasing neutron number. Analogies are made with the N = 86 system.

2888 **Radioactive decay of mass-separated ^{192}Tl and ^{192}Pb.** Sousa, D.C.; Riedinger, L.L.; Bingham, C.R.; Turner, F.E.; Toth, K.S.; Carter, H.K.; Mledkodaj, R.L.; Spejewski, E.H. (Physics Department, University of Tennessee, Knoxville, Tennessee 37916). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2245-2259(Nov 1981).

Mass separated radioactive sources of ^{192}Tl and ^{192}Pb were produced using an isotope separator connected on-line to a cyclotron. Gamma-ray multiscale spectra and electron singles spectra were acquired and γ-γ and (x-ray)-γ coincidence measurements were. Half-lives of the 2$^-$ and 7$^+$ thallium isomers were determined to be 9.4 +- 0.2 and 10.8 +- 0.3 min, respectively. The 7$^+$ isomer decays primarily to a group of negative-parity states built upon a 5$^-$ state at 1843.9 keV in ^{192}Hg. This structure has been interpreted as a two-neutron band involving i/sub 13/2/ and low-j neutrons. The decay of the 2$^-$ isomer populates the low-lying positive-parity states in ^{192}Hg in addition to a number of states in the region of 1—2.5 MeV; the properties of the six lowest positive-parity states are compatible with the triaxial-rotor predictions for γ∼37°, a value which also reproduces the structure of bands in adjacent odd-A nuclei. The ^{192}Pb decay to ^{192}Tl is found to have a half-life of 3.5 +- 0.1 min, rather than 2.2 min as reported by previous investigators. Most of the ^{192}Pb decays proceeds to levels at 167.5 and 1195.4 keV, assigned I/sup π/ = 1$^-$ and 1$^+$, respectively. The systematic variation of the 1$^+$ state in even-A Tl and Au nuclei is discussed in light of the trend of the h/sub 11/2/ proton state in odd-A Tl and Au isotopes.

2889 **Heavy-ion radiative capture in the ^{198}Pt+^{13}C system.** Branford, D.; d'Amato, F.X.; Sang, H.W. Jr.; Steadman, S.G. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2339-2342(Nov 1981).

The $^{198+13}$C→^{211}Po+γ heavy-ion radiative capture reaction was investigated at 60 and 57 MeV bombarding energies using a rabbit system to search for delayed α particles from the T/sub 1/2/ = 25.5 s isomeric state in ^{211}Po. A cross section σ< or ≈1 nb is reported for the total radiative capture cross section averaged over the center of mass energy range E/sub c.m/∼49—54 MeV. This result is consistent with statistical model calculations.

2890 **Elastic and inelastic scattering of ^{86}Kr from ^{208}Pb at 695 MeV.** Cheng-Lie, J.; Christensen, P.R.; Hansen, O.; Pontoppidan, S.; Videbaek, F.; Schuell, D.; Wen-Qing, S.; Baltz, A.J.; Bond, P.D.; Freiesleben, H.; Busch, F.; Flynn, E.R. (Niels Bohr Institute, University of Copenhagen, DK-2100 Copenhagen O, Denmark). *Physical Review Letters;* **47**: No. 15, 1039-1041(12 Oct 1981).

Elastic and inelastic scattering of ^{86}Kr on ^{208}Pb to discrete states have been measured at 695-MeV bombarding energy and the observed differential cross sections have been analyzed with a coupled-channels calculation. The obtained ion-ion potential differs significantly from those derived from previous poor-resolution experiments on similar systems, but is consistent with a global potential based upon lighter-mass systematics.

2891 **Nuclear data sheets for A = 193.** Shirley, V.S. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Nuclear Data Sheets;* **32**: No. 4, 593-679(Apr 1981).

Level schemes from radioactive decay and reaction studies are presented for all nuclei with mass number A = 193. The experimental data have been evaluated, and adopted levels, transitions, and other nuclear properties are given.

2892 **X-rays from 1 GeV ^{208}Pb + ^{208}Pb and ^{209}Bi + ^{209}Bi collisions.** Morenzoni, E.; Stoller, Ch.; Woelfli, W. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Kernphysik); Meyerhof, W.E.; Clark, D.L. (Stanford Univ., CA (USA). Dept. of Physics); Folkmann, F.; Vincent, P.; Mokler, P.H.; Armbruster, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). *Helvetica Physica Acta;* **52**: No. 3, 422(25 Jan 1980).

From Spring session of the Swiss Society of Physics; Basel, Switzerland (5 - 6 Apr 1979).

6520 Nuclear Properties And Reactions, A=220 And Above

REFER ALSO TO CITATION(S) 2859

2893 (IA—1356, pp 161-162) **Absolute yields from photofission of ^{238}U.** Kahane, S.; Wolf, A. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2894 (INDC(CCP)—135/LN, pp 23-24) **Investigation of neutron resonances of ^{247}Cm in the 0.5-20 eV energy range.** Belanova, T.S.; Kolesov, A.G.; Klinov, A.V.; Nikol'skij, S.N.; Poruchikov, V.A.; Nefedov, V.N.; Artamonov, V.S.; Ivanov, R.N.; Kalebin, S.M. Aug 1979. Dep. NTIS (US Sales Only).

In Translations of contributed Soviet papers submitted to the May 1979 IAEA advisory group meeting on transactinium nuclear data.

The neutron resonance parameters of ^{247}Cm were calculated from the transmission of a curium sample measured by the time-of-flight method. The neutron resonance parameters were calculated by the shape method using the single-level Breit-Wigner formula. Since the neutron resonance parameters of ^{244}Cm, ^{245}Cm, ^{246}Cm, ^{248}Cm, ^{243}Am and ^{240}Pu are well known, it was possible to identify the neutron resonances of ^{247}Cm from the measured transmission and calculate their parameters. We identified only five neutron resonances of ^{247}Cm with high values of 2gGAMMAsub(n). This is due to the fact that the ^{247}Cm content of the sample is low (1.7mg) and the resonances of this isotope are identified against the background of a large number of resonances of ^{244}Cm, ^{245}Cm, ^{246}Cm, ^{248}Cm, ^{243}Am and ^{240}Pu situated in the energy range in question.

2895 (INP—1014/PL, pp 490-532) **Recent experiments on the shape of the fission barrier.** Metag, V. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The experimental results on the shape of fission barrier are summarized. Information on single particle states are expected from electron spectroscopy of low lying states in the second minimum.

Discrepances between experimental and theoretical barrier hights established for neutron deficient Pu isotopes indicate severe defects in the calculations of fission barriers.

2896 **Decay of 13.9-min ^{241}Np.** Parekh, P.P.; Franz, E.; Katcoff, S.; Peker, L.K. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2240-2244(Nov 1981).

Decay of ^{241}Np (T/sub 1/2/ = 13.9 +- 0.2 min) was studied by γ-ray spectroscopy. The Np sources, prepared by the ^{238}U(α,p) and ^{244}/sup(/n,p3n) reactions, were chemically separated and purified. Eleven γ rays, mostly new, were observed between 42.0 and 929.7 keV, and their intensities per disintegration were determined. A decay scheme for ^{241}Np is proposed which helps to elucidate the level structure of ^{241}/sup ./ Comparison with nuclear reaction data is used to identify a 5/2$^-$ octupole vibrational state and to characterize some of the other levels.

2897 **Higher-order deformations of ^{232}Th and /sup 234,236,238/U.** Ronningen, R.M.; Melin, R.C.; Nolen, J.A. Jr.; Crawley, G.M.; Bemis, C.E. Jr. (Physics Department and Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). *Physical Review Letters;* **47**: No. 9, 635-639(31 Aug 1981).

We have measured the inelastic scattering of 35-MeV protons from ^{232}Th and from /sup 234,236,238/U. Angular distributions were extracted for J/sup π/ = 0$^+$—8$^+$ members of the ground-state rotational bands, and were analyzed with use of coupled-channels calculations for scattering from a deformed optical potential. The deformation parameter β_6 is positive for ^{232}Th and ^{234}U, nearly zero for ^{236}U, and negative for ^{238}U. The trends of the deformation parameters and multipole moments are explained qualitatively by a simple model.

2898 **Single nucleon knock-out in high energy heavy ion collisions.** Jain, B.K. (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). pp 161-163 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

2899 **Criterion for the optimum choice of a compound nucleus reaction for producing superheavy elements.** Aroumougame, R.; Gupta, R.K. (Punjab Univ., Chandigarh (India). Dept. of Physics). pp 241-242 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The possible reaction partners of a cool compound nucleus reaction for the synthesis of the elements Z = 104, 106 and 108 are studied in terms of the potential energy surfaces, interaction barriers and the nuclear shapes calculated within the frame work of the Fragmentation theory based on two centre shell model. An estimate of the total reaction cross-section suggests that for larger fusion probabilities, the mass and charge asymmetries are the only essential criterion for the optimum choice of a cooler compound nuclear reaction. Larger the mass and charge asymmetries, larger is the fusion cross-section.

2900 **Liquid drop and shell contributions to fission barrier heights from analysis of fission excitation functions.** Ramamurthy, V.S.; Kataria, S.K.; Kapoor, S.S. (Bhabha Atomic Research Centre, Bombay (India)). pp 243 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 2817, 2829, 2835, 2900

2901 (INP—1014/PL, pp 13-24) **High spin rotations of nuclei with the harmonic oscillator potential.** Cerkaski, M.; Szymanski, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Calculations of the nuclear properties at high angular momentum have been performed recently. They are based on the liquid drop model of a nucleus and/or on the assumption of the single particle shell structure of the nucleonic motion. The calculations are usually complicated and involve long computer codes. In this article we shall discuss general trends in fast rotating nuclei in the approximation of the harmonic oscillator potential. We shall see that using the Bohr Mottelson simplified version of the rigorous solution of Valatin one can perform a rather simple analysis of the rotational bands, structure of the yrast line, moments of inertia etc. in the rotating nucleus. While the precision fit to experimental data in actual nuclei is not the purpose of this paper, one can still hope to reach some general understanding within the model of the simple relations resulting in nuclei at high spin.

2902 (INP—1014/PL, pp 49-113) **Nucleus of very high spin states microscopic description.** Ploszajczak, M. 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Properties of nuclei with high spin are considered. Deformation energy surfaces are calculated using Strutinsky shell corrections and cranking model. From these pictures shapes of nuclei and heights of fission barrier are obtained. The structure of yrast isomers is also discussed.

2903 (INP—1014/PL, pp 221-223) **Influence of the shell nuclear structure on the diffusion process.** Kartavenko, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

This short report is devoted to the investigation of the shell structure influence of the intermediate nuclear system, formed in the process of collision of heavy ions with atomic nuclei, on the charge distribution.

2904 (INP—1014/PL, pp 247-249) **Inelastic scattering calculations.** Thiissen, W.J.G. (Technische Hogeschool Eindhoven (Netherlands)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Inelastic scattering on deformed nuclei can be calculated using adiabatic method in which one assumes that the target orientation is fixed during the interaction. Results of this method are compared with coupled channels calculations.

2905 (INP—1014/PL, pp 250-262) **Elastic transfer reactions.** Bohlen, H.G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

In the elastic scattering of heavy ions with similar masses the transfer of the mass difference leads to the same nuclear system. This process is called elastic transfer. The interference of elastic transfer and direct amplitude is considered in the DWBA frame.

2906 (INP—1014/PL, pp 263-275) **Break-up of complex particles into continuum.** Budzanowski, A. (Institute of Nuclear Physics, Krakow (Poland)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Break-up of the complex nuclear projectiles on heavy target is investigated. It is stated that at high energies break-up occurs for complex incident particles irrespective of their binding energies.

2907 (INP—1014/PL, pp 363-371) **Influence of channel coupling on high excited states.** Rotter, I. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The properties of highly excited nuclear state are investigated on the base of continuum shell model. The coupling of low lying discrete states with continuum is taken into account. Highly excited virtual level widths are calculated.

2908 (INP—1014/PL, pp 551-587) **Quasiparticle spectra above the yrast line.** Bengtsson, R. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)); Frauendorf, S. (Central Institute for Nuclear Research, Rossendorf, Germany). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Theoretical approach to noncollective excitations above the yrast line of deformed rotating nuclei is presented. Concepts that have been developed for the analysis of the nuclear spectrum near the ground state are employed. To incorporate the angular momentum the Routhian instead of the Hamiltonian is used to describe the system within HFB formalism. The considerations are restricted to axial shapes and rotation about the axis perpendicular to the symmetry axis. To find the energy spectra the quasiparticle formalism is applied. The calculations are compared with the experimental data for ^{167}Yb, ^{163}Ho and for ^{164}Er. The interaction between the g- and the s-band is investigated.

2909 (INP—1014/PL, pp 588-620) **Discussion of the cranked Hartree-Fock-Bogolyubov method in terms of simplified model.** Cwiok, S. (Politechnika Warszawska (Poland). Inst. Fizyki); Dudek, J. (Warsaw Univ. (Poland). Inst. Fizyki Teoretycznej); Szymanski, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The simplified model Hamiltonian describing a rotating nucleus is solved within HFB formalism. Simplifications in the Hamiltonian, which are of purely algebraic nature, lead in consequence to relatively small matrices and thus solutions of HFB equations can be examined in details without much computer effort. We believe that, despite simplifications, all general features characteristic for the model itself are still contained in our approach and that the main conclusions we draw are valid for more realistic Hamiltonians as well.

2910 (INP—1014/PL, pp 621-657) **Quasimolecular model in transitional nuclei.** Leander, G. (Lund Univ. (Sweden)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

A review is made of some recent developments in the application of the Bohr Hamiltonian to transitional nulcei. The primary concern is to understand the advantages and limitations inherent to the basic model and its many variants.

2911 (INP—1014/PL, pp 658-682) **Particle-rotor model description of odd-mass transitional nuclei.** Rekstad, J. (Oslo Univ. (Norway). Fysisk Inst.). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The particle-rotor model is used to describe the structure of nearly spherical nuclei. The explicit inclusion of the recoil term and modifications made for the single particle potential allows to achieve success in calculations.

2912 (INP—1014/PL, pp 704-714) **Angular momentum projected wave-functions.** Bengtsson, R. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)); Haakansson, H.B. (Lund Univ. (Sweden)). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

Angular momentum projection has become a vital link between intrinsic model-wavefunctions and the physical states one intends to describe. We discuss in general terms some aspects of angular momentum projection and present results from projection on e.g. cranking wavefunctions. Mass densities and spectroscopic factors are also presented for some cases.

2913 (INP—1014/PL, pp 715-820) **Ward-like identities, cluster-vibrational model and quasirotational pattern.** Paar, V. (Zagreb Univ. (Yugoslavia). Prirodoslovno Matematicki Fakultet). 1978. NTIS (US Sales Only).

From 16. winter school; Bielsko-Biala, Poland (20 Feb 1978).

The cluster - vibration model is discussed, with special emphasis on some of its consequences. The richness of the cluster-vibration model in different phenomena on and around the yrast line is demonstrated. The appearance of regularities, as well as of irregularities in odd- and even - A nuclei ("bandcrossing", "band mixing", "back-banding" etc.), and the mechanism of their generation in the cluster vibration model are discussed. An approach in the spherical representation of the cluster-vibration model is developed, which includes the dominant shell degree of freedom (cluster in the valence shell, the Pauli principle in this limited part of the Hilbert space is completely included) and the dominant collective degree of freedom (low-freguency quadrupole vibration).

2914 (JINR-D—4-80-385, pp 31-56) **Study on the mechanism of a radiative capture of neutrons by nuclei.** Bechvarzh, F. 1980. (In Russian). Dep. NTIS (US Sales Only).

From International school on nuclear structure; Alushta, USSR (14 Apr 1980).

The review of experimental results is given. It is devoted to the study of the simple mechanisms of the (n, γ) reaction, described in the frame of the single-particle theory by Lane and Lynn and the quasiparticle-phonon theory by Soloviev. To analyze a degree of validity of the single-particle theory the experimental data from the neutron capture at separated p wave resonances for the nuclei in the A=90-100 mass region are discussed in detail. Upon this analysis main attention is focussed on correlation properties of partial radiative widths. Crucial conclusions following from the quasiparticle-phonon theory for the width correlation properties of s wave resonances in the deformed nuclei are summarized. The existence of the effects expected on the basis of the Soloviev theory are confirmed by recent experimental results.

2915 (JINR-D—4-80-385, pp 57-88) **Study on fragmentation of one-quasiparticle and one-phonon states in the quasiparticle-phonon nuclear model.** Solov'ev, V.G. 1980. (In Russian). Dep. NTIS (US Sales Only).

From International school on nuclear structure; Alushta, USSR (14 Apr 1980).

The general assumptions of the quasiparticle-phonon nuclear model are given. This model describes the few-quasiparticle components of the wave functions at low, intermediate and high excitation energies. The method of strength functions which plays a key role in describing complex nuclei is also presented. A further development of the quasiparticle-phonon nuclear model is outlined. The fragmentation of one-quasiparticle and one-phonon states over nuclear levels is studied. The results on the fragmentation of deep hole states in spherical nuclei are presented, which describe well the experimental data. The neutron strength functions and their spin dependence are calculated. A good agreement with experiment is obtained. The energies and widths of the giant resonances are calculated in spherical and deformed nuclei. The information on the many-quasiparticle components of excited state wave functions is shown to be very scarce. The necessity of studying the few-quasiparticle configurations is pointed out.

2916 (JINR-D—12831, pp 215-227) **Problems of describing the cumulative effect in relativistic nuclear physics.** Baldin, A.M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

The problem of describing the cumulative effect i.e., the particle production on nuclei in the range kinematically forbidden for one-nucleon collisions, is studied. Discrimination of events containing cumulative particles fixes configurations in the wave function of a nucleus, when several nucleons are closely spaced and their quark-parton components are collectivized. For the cumulative processes under consideration large distances between quarks are very important. The fundamental facts and theoretical interpretation of the quantum field theory and of the condensed media theory in the relativistic nuclear physics are presented in brief. The collisions of the relativistic nuclei with low momentum transfers is considered in a fast moving coordinate system. The basic parameter determining this type of collisions is the energy of nucleon binding in nuclei. It has been shown that the short-range correlation model provides a good presentation of many characteristics of the multiple particle production and it may be regarded as an approximate universal property of hadron interactions.

2917 (JINR-D—12831, pp 424-438) **Taking into account of the Pauli principle in the quasiparticle-phonon nuclear model.** Solov'ev, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

The effect of an exact account taken of the Pauli principle and correlations in ground states in calculations in the framework of the quasiparticle-phonon model of a nucleus has been studied. It is elucidated when it is possible to use the random phase approximation (RPA) and when the Pauli principle should be exactly taken into account. It has been shown that in the quasiparticle-phonon model of a nucleus one may perform calculations with a precise account of the Pauli principle. In most of the problems calculations can be carried out with RPA-phonons.

2918 (ZfK—430(Vol.2), pp 23-59) **Formation of hot, dense matter in fast nuclear collisions. Theory and experiments.** Stoecker, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)); Buchwald, G.; Cusson, R.Y.; Graebner, G.; Greiner, W.; Hofmann, J.; Kruse, H.; Maruhn, J.A.; Mueller, B.; Pinkston, W.T. Dec 1980. Dep. NTIS (US Sales Only).

From International conference on extreme states in nuclear systems; Dresden, German Democratic Republic (4 Feb 1980).

High energy (Esub(LAB) >> 10 MeV/u) heavy ion collisions are investigated in a nuclear fluid dynamical model. We discuss the influence of the properties of the nuclear equation of state at high densities and strong thermal excitation on the reaction dynamics. We predict that sideways emission of matter will occur and that nuclear residues will obtain large transverse momenta. For collisions of equal nuclei at small impact parameters we expect four jet events, due to 'bounce-off' fragments, and the explosion of the remaining, highly excited matter perpendicular to the scattering plane. For the collision of a small projectile with a heavy target the flow of Mach-shock-matter at a characteristic angle to the beam direction is predicted. At intermediate impact parameters the possibility of using the bounce-off effect to study the nuclear equation of state is investigated. We present recent experimental data (mostly obtained in 4π counters) which support the prediction of high compression phenomena. These experiments were performed by selecting events of high multiplicity of low and intermediate energy fragments, which indicate nearly central collisions. He-fragments and also protons are observed, which, following their angular and energy spectra, can not be attributed to evaporative emission from a source moving along the reaction axis. Finally we discuss the formation of quark matter at very high energies. In this process rapid oscillations of the expanding dense quark matter may lead to pulsed emission of matter. These oscillating quark blobs may explain the abnormally enhanced geometrical cross sections observed recently in secondary collisions of projectile fragments with target nuclei.

2919 (ZfK—430(Vol.2), pp 60-75) **Quark-nuclear exotics.** Lukyanov, V.K.; Titov, A.I. (Joint Inst. for Nuclear Research, Dubna (USSR)). Dec 1980. Dep. NTIS (US Sales Only).

From International conference on extreme states in nuclear systems; Dresden, German Democratic Republic (4 Feb 1980).

The multiquark configurations are to be expected both in nuclei and in the systems appearing in nuclear reactions. Nq-states are determined as exotic ones and nuclear phenomena and processes where they may manifest are called the quark-nuclear exotics. There are two types of quark models: the quark bag models and the models of constituent quarks. The coupled channel method is used successfully for calculating the quark-nuclear wave functions and then for considering the quark-nuclear exotic phenomena, nuclear form factors, and reactions at high momentum transfers. Multiquark admixtures in nuclei are discussed for a deuteron. Form factors of the lightest nuclei ^{2}D, ^{3}He, ^{4}He have been measured at large momentum transfers. Cumulative processes with the pion production are specified by a simultaneous participation in reaction of several nucleons and by the large momentum transfers.

2920 (ZfK—430(Vol.2), pp 126-130) **Experimental test of the hypothesis of cumulative nuclear effect.** Stavinsky, V.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Dec 1980. Dep. NTIS (US Sales Only).

From International conference on extreme states in nuclear systems; Dresden, German Democratic Republic (4 Feb 1980).

Relativistic nuclei collisions has been formulated using the idea of scale invariance. The probability of particle production (inclusive cross sections) is proportional to the nucleus volume, and is equal to the sum of the scale-invariant contributions of the interaction of groups of nucleons of the nucleus with the target nucleon. An unambiguous relation exists between the dependence of the cross section on the energy of produced particle at a fixed emission angle and the angular dependence at a fixed energy of inclusive particle. Experimental data are given which are devoted to cumulative particle production by bombarding the nucleus with protons.

2921 (ZfK—430(Vol.2), pp 131-149) **Heavy ion interactions at intermediate energies.** Galitzkii, V.M.; Mishustin, I.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Dec 1980. Dep. NTIS (US Sales Only).

From International conference on extreme states in nuclear systems; Dresden, German Democratic Republic (4 Feb 1980).

The macroscopic nature of ion-ion collision allowed to formulate a number of new problems in nuclear physics. The problems are to study the properties of nuclear matter and its motion. They include nuclear matter equation of state, collective motions in nuclear matter and equilibrization processes. To treat experimental data theoretical models can be devided into three groups: cascade models, hydrodynamic models and 'participant-spectator' models. In the two last models thermodynamic equations are used. Thermodynamics and hydrodynamics relations were applied to the problem of multiple particle production in nucleon-nucleon collisions.

2922 **Reactive content of the Klein-Gordon optical potential.** Ernst, D.J.; Johnson, M.B. (Physics Department, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2210-2215(Nov 1981).

The reactive content of the pion-nucleus optical potential is explicated in the Klein-Gordon and relativistic Schroedinger theories. It is proven that even though the solution of the Klein-Gordon equation introduces intermediate multipion states, there is no inelastic contribution of these states to the scattering amplitudes. This is shown to come about from an intricate cancellation between diagrams which contain different numbers of pions at specific intermediate times. Approximation schemes which expand the optical potential of the relativistic Schroedinger equation in terms of a fixed number of pions present at a given time are shown not to maintain this cancellation whenever truncated at any finite order of perturbation theory.

2923 **Configuration space Faddeev calculations. V. Variational bounds.** Friar, J.L.; Gibson, B.F.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2279-2289(Nov 1981).

Three three-nucleon model problems are proposed as test cases for numerical computation: the ground and excited states of a spin-isospin independent Yukawa potential (Delves potential) and the ground state of a spin-isospin independent potential composed of one attractive and one repulsive Yukawa function (Malfliet-Tjon V). Eigenvalues and eigenfunctions are calculated using a configuration space Faddeev approach, and variational upper and lower bounds are evaluated using these wave functions. Each calculation is performed both as a projected s-wave potential problem, and as a true local potential problem in which nucleon-nucleon partial waves through $l = 6$ are kept. For each case the eigenvalue appears to be converged to within 1 keV and it agrees well with the upper bound. A brief review of bounding techniques is presented.

2924 **Dynamics of nuclear fluid. VI. Nuclear giant resonances as elastic vibrations.** Wong, C.; Azziz, N. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **24**: No. 5, 2290-2310(Nov 1981).

Starting with the previous result that the equation of motion for some collective motion of the nuclear fluid can be approximated by the Lame equation, we consider the nuclear giant resonances as elastic vibrations of a nucleus, the properties of elasticity being a peculiar manifestation of the quantum stress tensor. The nucleus is taken to be compressible and endowed with elastic moduli, surface tension, Coulombic charge, and two-body viscosity. Eigenenergies and widths for the isoscalar electric multipole states (0^+,1^-,2^+,3^-,4^+,...) and the isoscalar magnetic multipole states (1^+,2^-,3^+,4^-,...) are obtained. The energies and widths of the 0^+, 2^+, and 3^- states agree well with those of the observed giant resonances. Such agreement lends support to the present macroscopic description of the collective excitation of a nucleus. Nuclear viscosity coefficients and the incompressibility of nuclear matter are extracted. In the present unified approach, the high-lying electric multipole "giant resonance" states and the low-lying "liquid-drop" states emerge as eigenstates of the same characteristic equation. Similarities and differences between these two types of states are assessed.

2925 Superdense nuclei in degenerated nuclear plasma. Vartanyan, Yu.L.; Ovakimova, N.K. (Erevanskij Gosudarstvennyj Univ. (USSR)). *Astronomicheskii Zhurnal;* **57**: No. 3, 548-556(May-Jun 1980). (In Russian).

The properties of compressed matter with superdense nuclei in Fermi gas in the presence of π-condensate are studied. The calculation is performed for two possible sets of constants of nuclear interactions, one which gives the superdense, superbound nuclei, but other metastable ones, when an ordinary nucleus is bound more strongly than superdense one. Investigation is realized by both schemes of complete equilibrium and partial equilibrium. The configurations of white drafts with superdense superbound nuclei are calculated.

2926 Mean multiplicity of secondary particles in hadron-nuclear interactions. Alaverdyan, G.B. (Erevanskij Gosudarstvennyj Univ. (USSR)); Pak, A.S. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij); Tarasov, A.V.; Uzhinskii, V.V.; Tsehrehn, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Yadernaya Fizika;* **31**: No. 5, 1342-1349(1980). (In Russian).

The mean multiplicity of secondary particles in hA interactions is examined in the framework of the multiplex scattering theory. The dependence of the secondary particle multiplicity coefficient Rsub(6)=anti nsub(hA)/anti nsub(hN) (where anti nsub(hA) and anti nsub(hN) are mean multiplicities of secondary relativistic particles in hA and hN interactions, respectively) on the energy and type of incident particles and atomic number of a target nucleus is analysed. It is shown that predictions of the leading particle cascade model are in satisfactory agreement with the experimental data if the uncertainties of the inelasticity in hN interactions are taken into account. The value Rsub(A) weakly depends both on the incident particle energy and the form of parametrization anti nsub(hN)(E). Allowance of energy losses fluctuation of leading particle results in the Rsub(A) value decrease. From the model of leading particles it does not follow that Rsub(a) strictly depends on the type of incident particles at the fixed value of mean number of collisions. But quantitative values of Rsub(A) for different types of particles and at one value of anti ν, (i.e. at properly chosen value) coincide. The value of Rsub(A) is profoundly dependent on the values of inelasticity factor in hN interactions.

2927 Nuclear reactions with heavy ions. Bass, R. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik). Berlin, Germany, F.R.; Springer (1980). 410p.

This book is a monography about heavy ion reactions. After a general description of heavy ion reactions quasi-elastic scattering, nucleon transfer reactions, deep inelastic scattering, and complete fusion reactions are considered. Finally the decay of compound nuclei is discussed.

2928 Statistical theory of heavy ion reactions. Chapter 5. Deubler, H.H.; Dietrich, K.; Hofmann, H. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fachbereich Physik). pp 359-395 of Heavy ion collisions. Volume 2. Bock, R. (ed.) (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Amsterdam, Netherlands; North-Holland (1980).

The equation of motion which can be applied to a heavy ion collision is a Fokker-Planck equation for the density distribution in the classical phase space. The essential features of this equation are discussed and an attempt made to try to justify its conditions of validity. Computations based on simple models are compared with experimental data.

2929 Theory of fragmentation in fission, fusion and heavy ion scattering. Chapter 6. Maruhn, J.A.; Greiner, W. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Scheid, W. (Giessen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). pp 397-465 of Heavy ion collisions. Volume 2. Bock, R. (ed.) (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Amsterdam, Netherlands; North-Holland (1980).

The model for fragmentation, the precise definition of the coordinates and their relation to the asymmetric two-centre shell model (ATCSM) are discussed. In the framework of the ATCSM, using the Strutinsky formalism and the cranking model, all the components of the Hamiltonian of the model are calculated. The theory is applied to explain the measured mass and charge yields in fission. The fragmentation theory is used to predict the optimum combination of the projectile and target nuclei in order to obtain maximum fusion cross sections. The mass transfer in heavy ion scattering is investigated. Realistic scattering calculations are presented for the U + U system and measured mass yields are interpreted. The theory is extended to three-body fragmentation and applications suggested for the triple fission and three-body breakups in nucleus-nucleus collisions.

2930 Structure of high excited nuclear states and elastic scattering. Zhivopistsev, F.A.; Rzhevskii, E.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). *Izvestiya Akademii Nauk, Seriya Fizicheskaya;* **43**: No. 11, 2401-2407(Nov 1979). (In Russian).

From 29. All-union conference on nuclear spectroscopy and nuclear structure; Riga, USSR (27 - 30 Mar 1979).

An approach to a unified description of nuclear reactions and nuclear structure based on the formalism of the quantum Green functions and on the ideas of the theory of finite Fermi systems has been formulated. New structural vertices are introduced, which are responsible for nucleon collectivization in an atomic nucleus and for the excitation of many-phonon, quasideuteron, quasitriton and other configurations. The vertices define both the processes of particle scattering by atomic nuclei (T matrix and optical potentials) and the nuclear structure (secular equations and wave functions). The vertices are determined from the equations with effective many-particle forces Fsub(nm)sup(c). In their turn the Fsub(nm)sup(c) forces are either determined from a comparison of theory and experiment, or calculated from the equations with more fundamental nucleon-nucleon forces in a nucleus. The effective forces Fsub(nm)sup(c) are more universal than the constants of the theory of finite Fermi-systems, which extends the boundaries of applicability of the particle-hole formalism in the description of nuclear processes. In this approach the traditional methods of description of the nuclear structure, based on particular models of hamiltonian and wave functions, acquire a natural interpretation.

2931 Distorted wave method variants for the description of specific reactions with compound particles. Zelenskaya, N.S.; Teplov, I.B. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). *Izvestiya Akademii Nauk, Seriya Fizicheskaya;* **43**: No. 11, 2375-2388(Nov 1979). (In Russian).

From 29. All-union conference on nuclear spectroscopy and nuclear structure; Riga, USSR (27 - 30 Mar 1979).

The application of the method of distorted waves with a finite radius of interaction (MDWFR) to a quantitative analysis of characteristics of nuclear reactions with compound particles (heavy ions, ^{6}Li, ^{7}Li, ^{9}Be ions, α-particles) is studied. A general version of the MDWFR is based on the following suppositions: the matrix element of the nuclear reaction is analyzed in the framework of the three-body problem; instead of precise T, which are the soluton of the three-body problem equations, the interaction potentials are employed, i.e., only the one-step mechanisms of the reaction are taken into account; the nuclear interaction of particles is examined in the

framework of the optical model; the spin-orbital interaction is neglected. Different versions of MDWTR, from most sophisticated to most successive ones, have been summarized. The methods of exact and rough account for the finite radius interaction are discussed. Particular MDWTR programs are analyzed.

2932 **Semimicroscopic approach to the analysis of the radiative strength functions of the compound nucleus resonances.** Bondarenko, V.I.; Urin, M.G. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). *Izvestiya Akademii Nauk, Seriya Fizicheskaya;* **43**: No. 11, 2367-2374(Nov 1979). (In Russian).

From 29. All-union conference on nuclear spectroscopy and nuclear structure; Riga, USSR (27 - 30 Mar 1979).

The shell approach to the nuclear reaction theory (semimicroscopic approach) based on application of the methods of the many-body theory is employed in analyzing the complete radiative widths (anti GITA γ)sub(compl) and the corresponding strength functions of compound-nucleus resonances in the vicinity of the nucleon binding energy. Fundamental statements of the semimicroscopic approach and of the theoretical analysis of the low-energy part of the E1 photoabsorption cross section have been briefly formulated. A formula has been derived for calculating (anti GITA γ)sub(compl) in terms of the shell and optical models. The numerical calculations have been performed for a ^{143}Nd nucleus. A comparison of calculation results, quasiclassical estimation and of the experimental data shows that the expression obtained gives a satisfactory description of the experimental value of (anti GITA γ)sub(compl), whereas the quasiclassical estimate gives only the order of its magnitude. The analysis of (anti GITA γ)sub(compl) is carried out on the basis of the Brink hypothesis, according to which the gamma absorption by a nucleus in excited and ground states can be studied by one and the same method.

2933 **Shell effect influence on the nuclear statistic properties at large angular momenta.** Magner, A.G.; Kolomiets, V.M.; Strutinskii, V.M. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). *Izvestiya Akademii Nauk, Seriya Fizicheskaya;* **43**: No. 11, 2408-2416(Nov 1979). (In Russian).

From 29. All-union conference on nuclear spectroscopy and nuclear structure; Riga, USSR (27 - 30 Mar 1979).

The aim of this paper is to extend the expression for the level rho density with a fixed number of excited particles into the region of low excitation energies in the quasiclassical approximation. The dependence of the shell effect contribution to the value rho on the projection of the angular momentum is considered. Using the density rho an expression for the shell correction to the energy of the yrast-line of deformed nuclei is obtained at I=K (K is the projection of the total angular momentum of a nucleus onto the symmetry axis, I is the total angular momentum of the excited state of a nucleus), and alignment of nucleon angular momenta along the symmetry axis in heated nuclei is studied. The shell correction is an oscillating function of the number of nucleons in a nucleus, deformation parameters and of the mean value of the angular momentum. With increasing the nuclear temperature T the shell effects diminish exponentially and at the temperature T> or approximately Tsub(sh) approximately 2h/2π/tausub(F) they vanish (tausub(F) is the mean value of the nucleon rotation period in motion at the Fermi energy).

2934 **Studies in the statistical theory on nuclear fission.** Prakash, M.; Ramamurthy, V.S.; Kapoor, S.S. (Bhabha Atomic Research Centre, Bombay (India)). pp 245-248 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

With a view to predict the mass, charge and energy distributions in the framework of a statistical theory, detailed calculations have been performed on the basis that the average values of the observables correspond to the configurations of maximum entropy of the two fragment system near scission. Major improvements over the previous reported work of others are effected in the: (i) specification of the scission configuration, (ii) calculation of scission energy and (iii) calculation of the level density function. Special care has been taken to make the calculations free of parameter fitting. Results of calculations reveal good qualitative agreement with experimental features like dip at symmetry in the fragment kinetic energies as a function of fragment mass number, saw-tooth nature of excitation energy curve etc. However, it was not possible to obtain good quantitative agreement between the observed and predicted mass distribution of fragments in the fission of ^{236}U. In particular, the theoretical mass yield curve peaks at mass number 132 instead of the observed 140.

2935 **Nuclear matter calculations with a recent N-isobar potential.** Dey, M. (Bethune Coll., Calcutta (India)); Samanta, B.C. (Burdwan Univ., West Bengal (India)); Dey, J. (Presidency Coll., Calcutta (India)). pp 256-258 of Proceedings of the nuclear physics and solid state physics symposium [held at] Bombay, December 28-31, 1978. Vol. 21B. Nuclear physics. Bombay; Department of Atomic Energy (1979).

From Nuclear physics and solid state physics symposium; Bombay, India (28 Dec 1978).

The effect of $N_{33}(1236)$ isobar in nuclei has been investigated in detail by Prof. A.M. Green and his group with a NN to NN_{33} transition potential used in a coupled channel calculation. The effect of this N_{33} virtual state is to decrease the binding in nuclear matter at normal density by 5-7 Mev/A. The coupled channel formalism is closely related to the two-pion exchange potential being a dynamic component of the intermediate state. It was shown by Durso et al (1977) that the transition potential employed before 1977 when twice iterated did not agree with the two-pion box diagram. Since then Green et al (1978) have given a new potential which is in better agreement with the dispersion theoretic two-pion potential. This new potential has been used with the Reid and the Tourreil-Rouben Sprung potential in a full nuclear matter calculation to show that the extra repulsion is now only about 2 Mev from virtual isobar states. This result is in agreement with a model for estimating the extra repulsion.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 2667, 2960, 2961, 2962

2936 **Ion beam range shortening and the possibility of thermal instability.** Slutz, S.A.; Mehlhorn, T.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **39**: No. 11, 885-887(1 Dec 1981).

The range of an ion can be decreased when the deposition material is heated because of the greater stopping power of free electrons over bound electrons. This suggests the possibility that a medium heated by an intense ion beam might suffer a thermal instability. It is shown that such an instability should not be important over the regimes of interest for ion beam fusion.

2937 **Analytical and Monte-Carlo results of the absorption probability functions for irradiated spherical probes.** Kaplanis, S.N. (K.A.T.E.E. of Patras, Patra (Greece). Dept. of Physics); Rigopoulos, R. (Patras Univ. (Greece). Dept. of Physics). *International Journal of Applied Radiation and Isotopes;* **31**: No. 9, 569-573(Sep 1980).

A spherical probe and generally a spherical shell is considered under a uniform irradiation. Analytical expressions for the probability density function and the cumulative distribution function of the values of the distances from the probe's center where the radiation was absorbed are given. The analytical results are compared with results obtained by the Monte-Carlo simulation technique.

2938 **Empirical relation for electronic stopping power of heavy ions in carbon.** Garnir-Monjoie, F.S. (Liege Univ. (Belgium). Inst. de Mathematique); Garnir, H.P.; Baudinet-Robinet, Y.; Dumont, P.D. (Liege Univ. (Belgium). Inst. de Physique Nucleaire). *Journal de Physique (Orsay, France);* **41**: No. 7, 599-601(Jul 1980).

We propose a new simple empirical relation to calculate the electronic stopping power of carbon for heavy ions (Z>4) at non relativistic energies. This relation fits well the experimental data and can be easily coded on a small computer.

2939 Single and multiple scattering in electron trajectory simulation. Application to calculation of X-ray distribution in depth. Henoc, J. (Centre National d'Etudes des Telecommunications (CNET), Bagneux (France)); Maurice, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). *Journal de Microscopie et de Spectroscopie Electroniques;* **5**: No. 3, 347-355(Jun 1980). (In French).

From Symposium on the Monte Carlo simulation techniques of electron trajectories; Paris, France (4 Oct 1979).

Different treatments of electron trajectory simulation by Monte Carlo calculation are reviewed. Emphasis is put on several approaches dealing with the same single scattering distribution. No significant difference has been found in the X-ray distribution in depth which is the end result in our investigation.

2940 Backscattering of fast charge particle flat beam from a substance surface for sliding beam. Remizovich, V.S.; Ryazanov, M.I.; Tilinin, I.S. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). *Doklady Akademii Nauk SSSR;* **251**: No. 4, 848-851(1980). (In Russian).

Considered is the problem of charged particle reflection for sliding incidence on the substance surface of fast ion beam moving in one plane. Diffusion approximation in the velocity space has been used for the problem solution, while scattering has been considered as elastic. Derived is a formula of distribution function dependence of escaping particles on the distance between escape and entry points of the particle. Fulfilment of the following condition is necessary for applicability of the formula obtained: the slide angle should be less, than the characteristic deflection angle of the particles on their flight.

2941 Interpretation of laboratory findings. Mashkova, E.S.; Molchanov, V.A. pp 206-232 of Rasseyanie ionov srednikh ehnergij poverkhnostyami tverdykh tel. Moscow, USSR; Atomizdat (1980). (In Russian)

Various laboratory findings are analyzed which are obtained upon the study of the process of scattering of average energies ions by solids in the light of different theoretical models. Attention is drawn to the problem of uncontrolled parameters arising in the course of comparison of experimental and theoretical data. Main specific features of energy and angular distributions of ions scattered by polycrystals and monocrystals are analyzed. The results of researches specially performed for checking the scattering theories developed are considered.

2942 Nuclear shielding analyses for an intense neutron source facility. Celnik, J. pp 731-735 of Radiation protection. A systematic approach to safety. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

A summary is presented of a shielding analysis applicable to fusion-related facilities; a neutron environment of 3×10^{15} neutrons per second, of energy 14 MeV, and arising from D-T reactions is assumed. The bulk-shield analysis was performed using the computer code ANISN; the sensitivity of the calculations to the cross section data sets and angular distributions was investigated. The reduction of skyshine and the streaming of neutrons through access ports or penetrations are also described. Finally, the design of the source cell access door to produce maximum dose rates of 5 mRem/hr behind the door is outlined.

2943 Spectra, differential-albedo shielding data for bremsstrahlung scattered from common shielding materials. Weise, H.P.; Jost, P.; Freundt, W. (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). pp 766-769 of Radiation protection. A systematic approach to satisfy. Oxford, England; Pergamon Press (1980).

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

In 2 volumes.

Experimental measurements of the scattered γ-ray radiation from lead and concrete are reported. Such measurements are important in the design of radiation shields for x-ray machines and electron accelerators. Results for the differential exposure albedo are given for x-ray energies between 100 and 400 keV and for γ-ray energies between 10 and 35 MeV. For the low-energy region, although complicated, the results indicate that for normal incidence the scattered dose rate always increases with increasing scattering angle. Between 10 and 35 MeV, the differential albedo of materials with low atomic number decreases with increasing energy; for lead, however, the behaviour is reversed because of the higher production rate of secondary bremsstrahlung.

2944 Interaction of an intense relativistic electron beam with a matter. Didenko, A.N.; Chistyakov, S.A.; Yalovets, A.P. *Atomnaya Energiya;* **47**: No. 5, 328-332(Nov 1979). (In Russian).

Results of a numerical study of the interaction of an intense electron beam with a material are given. It is shown that energy transfer to the target material, aside from nonelastic collisions, is effected by the transition of the fast electron-field interaction Coulomb energy to the thermal energy in the scattering of the space charge generating the field. The studies reveal that the growth of the decreasing current density at the same medium conductivity leads to the redistribution of the energy being lost in the material, and an attempt has been made to explain the effect of abnormal energy absorption in thin foils as an intense electron beam passes through them.

2945 Nonregularity effect on the ondulator radiation spectrum. Gevorgyan, L.A.; Korkhmazyan, N.A. (Armyanskij Pedagogicheskij Inst., Erevan (USSR); Erevanskij Fizicheskij Inst. (USSR)). *Zhurnal Tekhnicheskoi Fiziki;* **49**: No. 11, 2481-2483(Nov 1979). (In Russian).

2946 Positron-phonon interaction and positron thermalization in ionic crystals and semiconductors. Varisov, A.Z. *Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika;* No. 10, 108(1979). (In Russian).

2947 Correspondence of the theory to experimental data in the Vavilov-Cherenkov effect. Novikova, G.P. (Gor'kovskij Gosudarstvennyj Univ. (USSR). Issledovatel'skij Fiziko-Tekhnicheskij Inst.). *Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika;* No. 11, 137(1979). (In Russian).

6550 Medical Physics

2948 (EUR—6813(Vol.2), pp 1120-1128) **Theoretical evaluation and experimental determination of (α,n) yields on light elements.** Cadic, M.; Capgras, A.; Dalmazzone, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Lab. de Metrologie des Rayonnements Ionisants). 1980. (In French). Dep. NTIS (US Sales Only).

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

The authors compare the results obtained by calculation as from data found in the literature with the experimental determinations. Yields are given for natural oxygen, carbon, beryllium and fluorine. The factors affecting these results are mentioned and comparisons are made with the works of various laboratories.

2949 (INIS-mf—6528, pp 102-105) **Production of certified radioactive reference materials in the National Office of Measures (OMH).** Jedlovszky, R.; Szokolyi, L.; Szoerenyi, A. (Orszagos Meresuegyi Hivatal, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

For more than ten years the National Office of Measures (OMH) has been issuing liquid and solid certified radioactive materials (CRM) - made at present of about 50 different nuclides. The paper summarizes the flow-diagram of the production of these CRM-s (chemical processes, impurity testing, determination of activity value, relative test measurements) and explains the data given in their certificates. A brief survey is given about the main types and technical data of OMH-made CRM-s.

2950 (INIS-mf—6528, pp 239-242) **Results and significance intercomparisons in the process of preparing radioactive certified reference materials.** Szokolyi, L.; Szoerenyi, A. (Orszagos Meresuegyi Hivatal, Budapest (Hungary)). 1980. (In Hungarian). Dep. NTIS (US Sales Only).

From 2. Hungarian symposium on radiochemistry; Debrecen, Hungary (3 Nov 1980).

To determine the activity (radioactive concentration) of radioactive certified reference materials (CRM) the National Office of Measures (OMH) applies absolute measuring methods. In order to check and reduce systematic uncertainties of measuring methods OMH currently participates in bilateral and multilateral intercomparisons. The paper reports on the results and experiences obtained during the latest intercomparisons (^{125}I, ^{134}Cs).

2951 (JINR-R—18-12147, pp 278-281) **Physico-dosimetric characteristics of neutron sources (reactor BR-10, accelerator KY-2.5 and neutron generator NY-150M).** Kapchigashev, S.P.; Obaturov, G.M.; Duba, V.V. (Akademiya Meditsinskikh Nauk SSSR, Obninsk. Nauchno-Issledovatel'ski Inst. Meditsinskoj Radiologii). 1979. (In Russian). Dep. NTIS (US Sales Only).

From 3. conference on application of new nuclear-physical methods for scientific, technical and national economy tasks; Dubna, USSR (12 Sep 1978).

Data are presented on physico-dosimetric characteristics of neutron beams from the reactor BR-10 channels, accelerator KG-2.5 targets and neutron generator NG-150M which are employed for radiobiological researches involving a wide range of objects and test effects. Investigations of the distribution of absorbed dose in phantoms involved the use of : X-dosimeters, standard ferrosulphate solutions, activation ^{197}Au and ferrosulphate dosimeters with addition of boric acid, a semiconductor dosimeter with a polyethylene radiator in the current regime, as well as the method based on the variation of optical density of polymethylmethacrylate under the effect of radiation. Computations were made for the spectrum of secondary particles, LET spectrum, distribution of absorbed dose and its constituents for the micron layers of tissue-equivalent substance during irradiation with neutrons.

2952 (NVO—232) **Radiation-safety manual for the Nevada Test Site.** (Reynolds Electrical and Engineering Co., Inc., Mercury, NV (USA); Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Oct 1981. Contract AC08-76NV00410. 176p. NTIS, PC A09/MF A01. Order Number DE82000864.

The Radiation Safety Manual for the Nevada Test Site (NTS) defines the minimum radiation protection standards for all personnel at the NTS. Radiation protection standards and guidelines on NTS policy and organization, training, personnel dosimetry, radiation monitoring, radiation area controls, personnel protective equipment, radioactive materials control, shipment of radioactive material, radiological safety in specific test areas, and emergencies are discussed. In addition, referenced codes amd standards are appended and requirements established by federal agencies are cited.

2953 **p(42)Be neutron therapy beams: Dose rate and penetration as a function of target thickness and beam filtration.** Rosenberg, I.; Awschalom, M.; Kuo, T.Y.; Tom, J.L. (Fermilab, Batavia, Illinois 60510). *Medical Physics;* **8**: No. 6, 808-812(Nov 1981).

It is shown that, in the production of p(42)Be neutron beams for clinical use, the use of semithick targets leads to more desirable beam characteristics when appropriate backstop materials are used. Furthermore, an algebraic representation of beam penetration and of dose per unit charge on target, including hardening by polyethylene filters, provides a method for target optimization. Key words: neutron, target, optimization, clinical, power, depth-dose

2954 **Status of radiation standards.** Harley, J.H. (DOE Env Measurements Lab, New York City). *Dangerous Properties of Industrial Materials Report;* **1**: No. 1, 2-7(Sep-Oct 1980).

Radiation standards have recently come into public view and have also become the subject of considerable controversy. Current standards are based on the concept that the risk from exposure to any amount of radiation is positive, that there is no threshold or safe level of radiation, and that no account is taken of possible biological recovery. Measures of radiation dose and biomedical considerations are reviewed.

6560 Solid State Physics

2955 (INIS-mf—6542, pp vp) **Critical diffusion in a 2-D Ising model.** Achiam, Y. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2956 **Dislocation-free zone model of fracture.** Chang, S.; Ohr, S.M. (Computer Sciences Division, Union Carbide Corporation, Nuclear Division, Oak Ridge, Tennessee 37830). *Journal of Applied Physics;* **52**: No. 12, 7174-7181(Dec 1981).

Recent observations by electron microscopy have shown that a dislocation-free zone (DFZ) is present between the crack tip and the linear pileup of dislocations in the plastic zone. A singular integral equation is formulated to describe the equilibrium configuration of the dislocations. The distribution function of the dislocations is obtained in terms of elliptic integrals. The condition of compatibility and the elastic stress intensity factor at the crack tip are also derived. At the crack tip the stress varies as $1/\sqrt{r}$. It is found that the stress intensity factor K is approximately a function of the length of the DFZ, whereas the externally applied stress approximately determines the length of the plastic zone. Based on the mechanism of dislocation generation at the crack tip proposed by Rice and Thomson, it is shown that the formation of the DFZ is anticipated when the stress intensity factor K is less than a critical stress intensity factor K/sub g/ defined for a spontaneous generation of dislocations. The magnitude of K/sub g/ relative to the critical stress intensity factor for brittle fracture K/sub c/ determines the brittle-ductile nature of a material.

2957 **Improved correlation corrections to the local-spin-density approximation.** Painter, G.S. (Metals and Ceramics Division, Oak Ridge, Tennessee 37830). *Physical Review [Section] B: Condensed Matter;* **24**: No. 8, 4264-4270(15 Oct 1981).

The accurate correlation energies for the para- and ferromagnetic states of the electron liquid calculated by Ceperley and Alder were recently used by Vosko, Wilk, and Nusair to produce a new correlation-energy density of increased accuracy and proper limiting behavior in the metallic density regime (r/sub s/< or =6). In the present work, the correlation potential in the local-spin-density approximation (LSDA) is derived from the correlation-energy-density representation of Vosko et al. Characteristics of the new exchange-correlation model are compared with those of the LSDA model of Gunnarsson and Lundqvist. Specific comparison is made between these models and exact results in the treatment of atomic and molecular hydrogen. Since the new treatment of correlation primarily affects the region of small r/sub s/, which is exchange dominated, correlation corrections are small compared with errors in the exchange energy. Thus, in light atoms the improved correlation model leads to a reduced cancellation of error between exchange and correlation energies, emphasizing the necessity for improved exchange treatment. For more homogeneous systems, the model should offer real improvement. The present results obtained with precise treatment of correlation within the prescription of Vosko et al. serve to define the present limitations of the LSDA and indicate the importance of nonlocal corrections, particularly for atoms.

2958 **Solitons in polyacetylene and relativistic-field-theory models.** Campbell, D.K.; Bishop, A.R. (Theoretical Division and Center for Nonlinear Studies, University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **24**: No. 8, 4859-4862(15 Oct 1981).

Using recent results on a model relativistic field theory, we find explicitly a new solitonlike solution, essentially the convention-

al strong polaron, in the continuum interacting electron-phonon model of a Peierls-dimerized chain such as polyacetylene [(CH)/sub x/]. This solution is in good agreement with recent numerical simulations in a discrete model of (CH)/sub x/. We discuss further areas in which known field-theory results may apply to (CH)/sub x/.

2959 **Toward a theory of impurities in amorphous semiconductors.** Dow, J.D.; Sankey, O.F. (Loomis Laboratory, of Physics and Materials Research Laboratory University of Illinois at Urbana-Champaign, Urbana, IL. 61801). *AIP (American Institute of Physics) Conference Proceedings;* **73**: No. 1, 141-145(Jun 1981). (CONF-810331—). Contract AC02-76ER01198.

From Conference on tetrahedrally bonded amorphous semiconductors; Carefree, AZ, USA (12 Mar 1981).

By drawing parallels with the theories of point and paired defects in crystalline materials, one can estimate which impurites are likely to form shallow dopants, deep traps, or suitable modifiers in amorphous semiconductors. It is suggested that Sb might behave differently from P and As in amorphous Si.

2960 **Orientation phenomena in charged particle radiation in monocrystals. Chapter 8.** Kalashnikov, N.P.; Remizovich, V.S.; Ryazanov, M.I. pp 212-236 of Stolknoveniya bystrykh zaryazhennykh chastits v tverdykh telakh. Moscow, USSR; Atomizdat (1980). (In Russian)

The coherent processes in scattering of nonrelativistic electrons and positrons in monocrystals are considered. The electron wave function in the field of a crystal and the laws of electron channeling are determined. Electromagnetic radiation of nonrelativistic electrons, connected with the change of the particle transverse moment state is calculated. For the case of ultrarelativistic electrons the spectrum of quasicharacteristic improvement with account for the orientation effects in usual bremsstrahlung and electron capturing into the transverse motion bound state is obtained.

2961 **Charged particle channeling in monocrystals. Chapter 7.** Kalashnikov, N.P.; Remizovich, V.S.; Ryazanov, M.I. pp 188-211 of Stolknoveniya bystrykh zaryazhennykh chastits v tverdykh telakh. Moscow, USSR; Atomizdat (1980). (In Russian)

The main laws of channeling and their manifestation in experiments on charged particle scattering and transport in monocrystals are considered. The channeling is described by the methods of classical mechanics, suggested by Linchard. The quantum theory of channeling based on the solution of the quantum kinetic equation is discussed. Kagan-Kononz solution for the function of transverse diffusion distribution is presented. Energy losses of channeling particles are considered.

2962 **Orientation effects in coherent scattering of charged particles in monocrystals. Chapter 6.** Kalashnikov, N.P.; Remizovich, V.S.; Ryazanov, M.I. pp 160-187 of Stolknoveniya bystrykh zaryazhennykh chastits v tverdykh telakh. Moscow, USSR; Atomizdat (1980). (In Russian)

The orientation effects in elastic scattering of fast charged particles in monocrystals are discussed. The effects of diffraction and interference in the process of scattering on a separate atom a chain of atoms and in monocrystals are considered. The expressions for total cross section and differential elastic scattering of particles in crystals of different thickness are obtained.

2963 **Internal friction and ultrasonic attenuation in solids.** Smith, C.C. Oxford, England; Pergamon (1980). vp. (CONF-7907107—).

From 3. European conference on internal friction and ultrasonic attenuation in solids; Manchester, UK (18 Jul 1979).

Individual papers are abstracted separately for the data base.

6561 Superconductivity

REFER ALSO TO CITATION(S) 2110, 2118, 2123, 2125, 2131

2964 **Charge-imbalance fluctuations in superconductors.** Lemberger, T.R. (Department of Physics, University of California and Materials, and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **24**: No. 7, 4105-4108(1 Oct 1981).

We calculate that the mean-square amplitude of the fluctuations of the condensate chemical potential μ/sub s/ due to charge-imbalance fluctuations in the limit Δ/k/sub B/T $<<$ 1 is $<(\delta\mu$/sub s/$)^2> = 2(k$/sub B/T$)^3/\pi\delta\Omega N(0)$ in a volume Ω of superconductor. We relate these fluctuations via Nyquist's theorem to measured values of the contribution of self-injected charge imbalance to the dc resistance of SIN tunnel junctions. In this relation the dynamic charge-imbalance relaxation rate is 1/tau/sub E/, the electron-phonon scattering rate.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 2640, 2798

2965 (IA—1356, pp 6) **Automatic generation of multiple time scale expansions.** Weissman, Y. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2966 (IA—1356, pp 6-7) **Semiclassical treatment of anharmonic oscillators.** Weissman, Y. (Israel Atomic Energy Commission, Tel Aviv); Jortner, J. (Tel Aviv Univ. (Israel)). Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2967 (IA—1356, pp 11-12) **Semi-analytic model for the static structure and the thermodynamics of dense fluids in D-dimensions.** Rosenfeld, Y. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2968 (INIS-mf—6542, pp vp) **Generalization of the mass operator to Riemannian space-times.** Huleihil, K.; Malin, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2969 (INIS-mf—6542, pp vp) **Isotropic anisotropy, group of motion and dimensionality of spacetime.** Leibowitz, E. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2970 (INIS-mf—6542, pp vp) **Accelerated system with euclidean spatial geometry.** Dana, I. (Technion-Israel Inst. of Tech., Haifa). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2971 (INIS-mf—6542, pp vp) **Magnification of singularities of the thermodynamic quantities near critical points in the presence of a chemical reaction.** Gitterman, M. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics); Steinberg, V. (Tel Aviv Univ. (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2972 (JINR-D—12831, pp 143-148) **Possibility of measuring an electromagnetic field in general relativity theory.** Markov, M.A. (AN SSSR, Moscow. Fizicheskij Inst.). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

Potentialities of measuring an electromagnetic field in the general relativity theory (GRT) have been analyzed. The role of taking account of the gravitation field specificity and of the presence of three universal constants c, $h/2\pi$, x (c is the light velocity, $h/2\pi$ is the Planck constant, x is the gravitational constant) is considered. The region, in which the averaged electromagnetic field is measured, has been shown to increase with charge up to infinity, and the error in measuring the field decreases with increasing the charge of a test body. It is noted that quantization of charge results in the same limitations in the accuracy of measuring the electromagnetic field in the GRT, as those obtained on quantization of gravitation.

2973 (JINR-D—12831, pp 487-511) **Geometric approach to relativistic mechanics of point particles.** Todorov, I.T. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). 1979. (In Russian). Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

It has been shown that it is possible to construct successively the relativistic dynamics of directly interacting point particles in the framework of hamiltonian formalism. Construction of bonds for a three-particle system according to the given bonds of its two-particle subsystems is discussed. The choice of a surface of equal times for the two-particle interaction serves as predetermination for gauging. A relative motion of two particles and the classical scattering matrix are shown to be independent of gauging. A bond has been revealed in a quasipotential approach which complitely defines the dynamics of a free particle. Realizability and practical applicability of the equations obtained have been demonstrated.

2974 (JINR-D—12831, pp 480-486) **Structure of additive conservation laws.** Helmut R. (Goettingen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1979. Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

All additive conserved quantities are listed for a system with short range central force interaction between the particles: a special case shows up in Boltzmann H-theorem and his derivation of the Maxwell velocity distribution. It is concluded that in classical mechanics of mass points there are no other additive conservation laws besides of energy, momentum, angular momentum and center of mass motion. A generator is considered of a symmetry transformation defined as integral over a conserved local current density where the latter, in general, needs not be covariant under translations.

2975 (JINR-D—12831, pp 474-479) **Structural stability theory of phase transitions. Compact phase space.** Mario R. (Turin Univ. (Italy). Ist. di Fisica). 1979. Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

Structural stability theory of phase transitions and compact phase space are considered. The difficulties are discussed of the problems on the calculation of the Atiyah-Singer index which is numerically reconducible to the evaluation of the asymptotic form of a suitable zeta function. It is shown that the scheme of the theory received requires a stable vacuum of the associated quantum theory for almost all points of S. The consideration is restricted to Cartan representations anti Gsub(K) of class 1 relative to K, namely to the case when the finite dimensional Hilbert space has a non-zero K-fixed vector.

2976 (JINR-D—12831, pp 439-447) **Entropy in quantum statistics.** Uhlmann, A. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). 1979. Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

An entropy inequality and the so-called strong subadditivity are shown to be connected one-to-another. One striking difference between classical and quantum entropy lies in the failure of monotonicity for the latter. The entropy of a subsystem can be strictly larger than the entropy of the total system. It is shown that in view of the non-monotonicity of the quantum entropy it is important that most of the properties of entropy known in classical statistics remain valid in the quantum case too.

2977 (JINR-D—12831, pp 393-400) **Electron gas, classical fluid and liquid helium.** Akira I. (Azerbajdzhanskij Inst. Nefti i Khimii, Baku (USSR)). 1979. Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

Three fundamental subjects of many-body theory of condensed matter: electron gas, classical fluid and liquid helium are discussed. The general treatment of gas-liquid condensation in classical statistical mechanics is presented. It is concluded that the van der Waals equation has been obtained in the long-range limit of the attractive potential for arbitrary dimensions. With the help of the Maxwell construction it is possible to obtain a stable phase separation curve of the distribution function. The case of two-dimensional electron correlations is considered. It is shown that the collective interactions in fluids depend not only on density but also on temperature.

2978 (JINR-D—12831, pp 363-381) **Polaron problem and the Boltzmann equation.** Devreese, J. 1979. Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

A mobility theory for the Feynman polaron is developed. It is shown that the Boltzmann equation for polarons is valid for weak coupling and not too high electric fields. The analytical results indicate that for $E \rightarrow 0$ the relaxation time approximation is valid. A comparison is made of three methods to calculate the mobility in a linear electron transport theory. An approximation to the Kubo formula, a mobility calculation using path integrals by Feynman and a calculation based on the displaced Maxwell distribution function are considered. The three methods lead to equivalent results in the weak scattering and small electric field limit.

2979 (JINR-D—12831, pp 21-81) **New notions about space-time and gravitation.** Logunov, A.A.; Denisov, V.I.; Vlasov, A.A.; Mestvirishvili, M.A.; Folomeshkin, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1979. Dep. NTIS (US Sales Only).

From Fundamental problems of theoretical and mathematical physics conference; Dubna, USSR (23 Aug 1979).

The formulation of the gravitation theory as the theory of symmetric tensor of the second rank field in flat space-time is considered. Usual conceptions about carrying energy by physical fields have strict meaning and the gravitational field carriers, as well as all the other physical fields, positively definite energy-momentum. The equations of motion for matter are formulated in terms of effective Riemann space-time with the metric tensor gsub(ik), thus leading to the equality of inertial and gravitational masses of a point body in this theory. Unification of the conception of gravitational field as a physical one, carrying energy and analogous to other physical fields with the identity principle brings one to new equations for gravitational field and changes our understanding of space-time. The equations of gravitational field inside the matter are nonlinear due to nonlinear dependence of the source on gravitational field components. Outside the matter the field equations are linear.

2980 **Efficiency of thermal engines with power output: Consideration of inertial effects.** Fairen, V.; Ross, J. (Department of Chemistry, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **75**: No. 11, 5485-5489(1 Dec 1981).

We consider an idealized heat engine with nonzero power output, which receives heat from and rejects heat to reservoirs by linear heat conduction and produces work in the surroundings by providing kinetic and potential energy to a mass in the gravitational field. The working fluid of the engine is in internal equilibrium. For this engine we write the equations of motion including inertial effects, i.e., we include Newton's equation for conservation of momentum. We define variables, controls, parameters, and boundary conditions in these equations in connection with the optimization of

some performance (cost) functional. The conceptual neglect of inertial effects, as has been done previously, is shown to change the set of variables and controls, thus changing the optimization problem. Furthermore, the neglect of these terms leads to requirements of energy balance which must be incorporated as boundary conditions. We do not solve any optimization problem explicitely but show that appropriate inclusion of inertial effects in such engines precludes in the optimal cycle the existence of isothermal branches which are not preceded and followed by acceleration and deceleration branches.

2981 **Efficiency of thermal engines with power output: Harmonically driven engines.** Fairen, V.; Ross, J. (Department of Chemistry, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **75**: No. 11, 5490-5496(1 Dec 1981).

In a previous article we defined and studied a model of a heat engine with the purpose of emphasizing the role of inertial effects, particularly their importance in relation to optimization problems. Here we pursue our argument on this issue by comparing the performance of models of heat engines harmonically driven around a state of equilibrium. For the first model, with inertia, we define the model, calculate its nonlinear response with emphasis on the linear approximation, and discuss the issues related to the coupling of the thermal and mechanical driving forces. We study the influence of increasing values of the mechanical friction coefficient, and show that when this coefficient is small the work output displays subharmonic resonances that disappear when the friction coefficient increases. In the second model, without inertial effects, no such resonances appear as expected, since these are due only to the inertial terms.

2982 **Decay of statistical dependence in chaotic orbits of deterministic mappings.** Grebogi, C.; Kaufman, A.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] A: General Physics;* **24**: No. 5, 2829-2830(Nov 1981).

A numerical study is made of the decay of statistical dependence in chaotic orbits of the iterated mappings of Chirikov and of Rannou. The decay appears to be exponential; the decay exponent is proportional to, but smaller than, the Liapunov exponent.

2983 **Self-energy of a charge near a surface.** Manson, J.R.; Ritchie, R.H. (Department of Physics and Astronomy, Clemson University, Clemson, South Carolina 29631). *Physical Review [Section] B: Condensed Matter;* **24**: No. 8, 4867-4870(15 Oct 1981).

A new, general expression for the space-dependent self-energy of a projectile interacting with a many-particle target is derived. The exchange-correlation potential or image potential experienced by a charged particle exterior to, but near a surface, is calculated from this expression using a model in which the charge interacts with collective surface excitations. It is found that recoil is important near the surface and gives rise to interesting new quantum effects. Previously obtained classical and semiclassical results are shown to arise simply and readily from the formalism. The connection with surface bound states is discussed briefly.

2984 **Determining the refractive index and thickness of thin films from prism coupler measurements.** Kirsch, S.T. (MIT Department of Electrical Engineering ampersand Computer Science and Research Laboratory of Electronics, Cambridge, Massachusetts 02139). *Applied Optics;* **20**: No. 12, 2085-2089(15 Jun 1981).

A simple method of determining thin film parameters from mode indices measured using a prism coupler is described. The problem is reduced to doing two least squares straight line fits through measured mode indices vs effective mode number. The slope and y intercept of the line are simply related to the thickness and refractive index of film, respectively. The approach takes into account the correlation between as well as the uncertainty in the individual measurements from all sources of error to give precise error tolerances on the best fit values. Due to the precision of the tolerances, anisotropic films can be identified and characterized.

2985 **Surface effects in heat transfer calculations.** Solomon, A.D. (Union Carbide Corp., Oak Ridge, TN). *Computers and Chemical Engineering;* **5**: 1-5(1981). Contract W-7405-ENG-26.

The use of extrapolation for surface effects in heat transfer calculations is discussed. An example is given for a phase change process with a convection boundary condition.

2986 **Expression for the melting time of a rectangular body.** Solomon, A.D. (Union Carbide Corp., Oak Ridge, TN). pp 379-384 of Letters in heat and mass transfer. Volume 7. New York, NY; Pergamon Press Ltd. (1980). Contract W-7405-ENG-26.

A simple expression is given for the melting time of a rectangular body; its verification by numerical methods is then described.

2987 **Moving weighted least-squares methods.** Lancaster, P. (Calgary Univ., Alberta (Canada)). pp 103-120 of Polynomial and spline approximation. Theory and applications. Sahney, B.N. (ed.). Dordrecht, Netherlands; Reidel (1979).

From NATO Advanced Study Institute; Calgary, Canada (26 Aug 1978).

Moving weighted least squares are defined and analyzed with a view to clarifying their algebraic structure and imposing sufficient conditions to guarantee interpolating and smoothness properties of the resulting surface.

6580 Mathematical Physics

2988 (IA—1356, pp 24-25) **Identities for associative rings.** Ilamed, Y. Apr 1980. Dep. NTIS (US Sales Only).

In Research laboratories annual report 1978 and 1979.

2989 **Convergence of semigroups with an application to the Carleman equation.** Kaper, H.G. (Argonne National Lab., IL); Leaf, G.K.; Reich, S. *Math. Meth. in the Appl. Sci.;* **2**: 303-308(1980).

A simple proof of a convergence result for nonlinear semigroups is presented which can be applied to obtain the fluid dynamical limit of Carleman's equation. In addition, a closed exponential generator of the limit semigroup is explicitly identified.

2990 **Complex analysis, microlocal calculus and relativistic quantum theory. Proceedings.** Iagolnitzer, D. (ed.). Berlin, Germany; Springer (1980). vp. (CONF-7909159—).

From International colloquium of complex analysis, microlocal calculus and relativistic quantum field theory; Les Houches, France (3 Sep 1979).

Separate abstracts were prepared for individual papers.

2991 **Vector-valued polynomial and spline approximation.** Hall, C. (Pittsburgh Univ., PA (USA). Inst. for Computational Mathematics and Applications). pp 35-67 of Polynomial and spline approximation. Theory and applications. Sahney, B.N. (ed.). Dordrecht, Netherlands; Reidel (1979).

From NATO Advanced Study Institute; Calgary, Canada (26 Aug 1978).

Blended interpolation of vector-valued functions is discussed relative to their applications in the construction of finite elements, mesh generation and table look-up of thermodynamic properties of a gas or liquid. The invertibility of two isoparametric transformations is investigated.

2992 **Simultaneous approximation of function and derivative on [0, infinitely] and an application to initial value problems.** Hall, C. (Pittsburgh Univ., PA (USA). Inst. for Computational Mathematics and Applications). pp 83-90 of Polynomial and spline approximation. Theory and applications. Sahney, B.N. (ed.). Dordrecht, Netherlands; Reidel (1979).

From NATO Advanced Study Institute; Calgary, Canada (26 Aug 1978).

Convergence of the approximation of a class of functions defined on [0, infinitely] and their derivatives by exponomials and La-

guerre functions is established. These results are used in the analysis of a new finite element type for initial value problems.

2993 **Polynomial splines and difference equations.** Meinardus, G. (Gesamthochschule Siegen (Germany, F.R.)). pp 131-135 of Polynomial and spline approximation. Theory and applications. Sahney, B.N. (ed.). Dordrecht, Netherlands; Reidel (1979).

From NATO Advanced Study Institute; Calgary, Canada (26 Aug 1978).

This is an elementary introduction to polynomial spline functions. The existence and uniqueness of the B-splines is proved. A special representation of those functions leads to many properties and, in particular, to the fact that they form a basis of the splines. The concept of linear difference equation is discussed. Eventually the connection of spline interpolation problems with linear difference equations is pointed out. This lecture will give the simple connection between the concept of polynomial spline functions and that of linear difference equations. It therefore yields some explanation of the well-known fact that in interpolation problems with splines one has to deal with matrices of band structure.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 2661, 3125, 3126

2994 (CONF-810511—, pp 311) **Prospects for EBT-R potential control.** McNally, J.R. Jr. (Oak Ridge National Lab., TN). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

2995 (INIS-mf—6542, pp vp) **Non-ideal effects on the stability of a cylindrical current-carrying plasma.** Gomberoff, L. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2996 (INIS-mf—6542, pp vp) **Electrostatic instability of rippled, magnetically focused, non-neutral, cylindrical beams of charged particles.** Cuperman, S.; Petran, F. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2997 (INIS-mf—6542, pp vp) **Parametric dependences of the beam-plasma-discharge at low pressures and magnetic field strengths.** Cuperman, S.; Roth, I. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Bernstein, W. (Rice Univ., Houston, TX (USA). Dept. of Space Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2998 (INIS-mf—6542, pp vp) **Structure of the particle distribution functions and the dispersion relation in magnetic mirror configurations.** Gomberoff, L.; Cuperman, S. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

2999 (INIS-mf—6542, pp vp) **Density of Cd I and Cd II excited states in a multi-cathode-spot vacuum arc? Pt. 1. Spatial dependence.** Shalev, S.; Goldsmith, S. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Boxman, R.L. (Tel Aviv Univ. (Israel). Dept. of Engineering Sciences). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

3000 (INIS-mf—6542, pp vp) **Density of Cd I and Cd II excited states in a multi-cathode-spot vacuum arc. Pt. 2. Temporal dependence.** Shalev, S.; Goldsmith, S. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Boxman, R.L. (Tel Aviv Univ. (Israel). Dept. of Engineering Sciences). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

3001 (INIS-mf—6542, pp vp) **Instability of relativistic electron beam in conical diode.** Goren, Y.; Segalov, Z.; Carmel, Y.; Eylon, S.; Ginzburg, A. (Government of Israel Scientific Department, Haifa, Israel). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

3002 (INIS-mf—6542, pp vp) **Incidence angles of electrons in the pinch region of large aspect ratio relativistic electron beam diodes.** Maron, Y. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

3003 (INIS-mf—6542, pp vp) **Modification of energy deposition in foil anodes of pinching relativistic electron beam diodes by external Bsub(theta) fields.** Maron, Y.; Blaugrund, A.E. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

3004 (INIS-mf—6542, pp vp) **Z dependent absorption and stimulated backscatter process in laser produced plasmas.** Jackel, S.; Loebenstein, H.M.; Zigler, A.; Zmora, H.; Zweigenbaum, S. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

3005 (INIS-mf—6542, pp vp) **Cell theory and the 1/T perturbation expansion in relation to isostructural phase transition due to core collapse.** Giv'on, M. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics); Rosenfeld, Y.; Thieberger, R. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

3006 (INIS-mf—6542, pp vp) **Statics and thermodynamics of strongly coupled multicomponent plasmas.** Rosenfeld, Y. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1980. Dep. NTIS (US Sales Only).

From Israel Physical Society annual meeting; Rehovot, Israel (9 Apr 1980).

3007 **Heterodyne measurements of electron cyclotron emission from Alcator A and absolute submillimeter receiver calibration.** Woskoboinikow, P.; Praddaude, H.C.; Falconer, I.S.; Mulligan, W.J. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Applied Physics;* **52**: No. 12, 7099-7106(Dec 1981).

Electron cyclotron emission (ECE) from thermal plasmas in the Alcator A tokamak for harmonics from 2nd through 5th and up to the 7th harmonic for nonthermal plasmas have been observed in the frequency range of 400—800 GHz using a sensitive, low-noise submillimeter heterodyne receiver. The sensitivity of the receiver ($\sim 10^{-20}$ W Hz^{-1}) allowed for the measurement of 4th and 5th har-

monic ECE from thermal plasmas with T/sub e/roughly-equal800 eV. The receiver was absolutely calibrated and its field of view was experimentally determined. A careful analysis has been made to relate the receiver calibration to the plasma-emitting volume, taking into account radiation coherence time, wall reflections, polarization scrambling, window losses, and aperture restrictions.

3008 **Finite Larmor radius model for axisymmetric compact toroids.** Seyler, C. Jr.; Barnes, D.C. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physics of Fluids;* **24**: No. 11, 1989-1998(Nov 1981).

Stability equations for axisymmetric compact toroidal configurations without a toroidal magnetic field are derived in a variational form. The application of a particular ordering procedure gives equations which include the coupling of geometry to finite Larmor radius as well as including resonant ion effects. The equations are readily obtained by applying the ordering assumptions to a variational dispersion functional form of the Vlasov-fluid equations. Application of the dispersion functional to find necessary and sufficient conditions for stability are made for the case of small, but finite Larmor radius and for the case of zero Larmor radius. The mathematical result that the zero Larmor radius case is more optimistic is physically understood in the context of an interesting stabilizing mechanism involving parallel kinetic effects.

3009 **Plasma equilibrium with rational magnetic surfaces.** Boozer, A.H. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* **24**: No. 11, 1999-2003(Nov 1981).

The self-consistent classical plasma equilibrium with diffusion is studied in a toroidal geometry having a sheared magnetic field. Near each rational surface it is found that the pressure gradient is zero unless the Fourier component of $1/B^2$, which resonates with that surface, vanishes. Despite the resonances, the overall plasma confinement is, in practice, only slightly modified by the rational surfaces.

3010 **Finite Larmor radius stabilization of ballooning modes in tokamaks.** Tsang, K.T. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physics of Fluids;* **24**: No. 11, 2017-2021(Nov 1981).

A ballooning mode equation that includes full finite Larmor radius effects has been derived from the Vlasov equation for circular tokamak equilibrium. A numerical solution of this equation shows that finite Larmor radius effects are stabilizing.

3011 **Currents generated by lower hybrid waves.** McWilliams, R.; Motley, R.W. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* **24**: No. 11, 2022-2034(Nov 1981).

Electron currents can be driven in a linear plasma by the absorption of lower-hybrid waves excited primarily in one direction. Current-drive has been demonstrated both for collisional and resonant-electron absorption. The magnitude of the excited current is compared with the predictions from an electron kinetic equation with a Lorentz collision operator in the regime k/sub parallel/v/sub t/e/$\omega << 1$.

3012 **Field-reversed experiments (FRX) on compact toroids.** Armstrong, W.T.; Linford, R.K.; Lipson, J.; Platts, D.A.; Sherwood, E.G. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Physics of Fluids;* **24**: No. 11, 2068-2089(Nov 1981).

Equilibrium, stability, and confinement properties of compact toroids produced in field-reversed theta-pinch experiments (FRX) are reported. Two experimental facilities, FRX-A and FRX-B, have been used to study highly elongated compact toroid plasmas confined in a purely poloidal field geometry. Spatial scans and fill pressure scaling of the equilibrium plasma parameters are presented. Plasma conditions range from T/sub e/$\sim$150 eV, T/sub i/$\sim$800 eV, n/sub m/$\sim 1 \times 10^{15}$ cm^{-3} to T/sub e/$\sim$100 eV, T/sub i/$\sim$150 eV, n/sub m/$\sim 4 \times 10^{15}$ cm^{-3}. Typical confined plasma dimensions are: major radius R$\sim$4 cm, minor radius a$\sim$2 cm, and total length 35—50 cm. The plasma configuration remains in a stable equilibrium for up to 50 μsec followed by the destructive n = 2 rotational instability. The stable period prior to the onset of the rotational mode is up to one hundred times greater than characteristic Alfven transit times of the plasma. This stable period increases and the mode growth rate decreases with increased a/rho/sub i/ (where rho/sub i/ is the ion gyroradius). Agreement of experimental and theoretical mode frequencies for the instability is observed. Preferential particle loss has been proposed as a likely cause of rotation. The particle inventory at the onset of the instability is consistent with this hypothesis. The particle loss rate is also consistent with the predicted anomalous transport near the separatrix. Contributions to rotational instability from diffusion, end-shorting, equipartition, and compression are also discussed.

3013 **Observation of harmonics in the visible and ultraviolet created in CO_2 laser-produced plasmas.** Carman, R.L.; Rhodes, C.K.; Benjamin, R.F. (Los Alamos National Laboratory, Los Amalos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **24**: No. 5, 2649-2663(Nov 1981).

Experimental studies of inertially confined plasmas irradiated with CO_2 laser intensities greater than 10^{15} W/cm^2 at 10.6-μm wavelength reveal the generation of harmonic spectral components up to the 46th order ($\sim$230 nm). These harmonics are of very short duration (<200 ps), have a polarization parallel to that of the incident 10.6-μm electric field, and exhibits a conversion efficiency approximately independent of the harmonic order up to a maximum order. The plasma-physics phenomena responsible for the high-harmonic emission are examined. The data and theory are consistent with the presence of self-focusing.

3014 **Two-dimensional spatial distribution of volume emission from line integral data.** Navarro, A.P.; Pare, V.K.; Dunlap, J.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Review of Scientific Instruments;* **52**: No. 11, 1634-1643(Nov 1981).

A method is presented for determining the two-dimensional (2-D) spatial distribution of the volume emission intensity [E = f(r,θ)] in a plasma from line integral data obtained by arrays of collimated detectors looking through the plasma along different chords. Subject to the assumption that E can be represented by summation/sub m/ [f/sub m/(r)cos mθ + g/sub m/(r)sin mθ] with only a few terms m, expressions are developed that separate harmonic contributions to the line integrals, a numerical procedure is outlined for inversion of these contributions to obtain the factors f/sub m/(r) and g/sub m/(r), and the formulas that result are presented for m = 0 through m = 5. This method was developed for application to data from arrays of soft x-ray detectors on the Impurity Study Experiment (ISX-B) tokamak. One use would be comparison of the soft x-ray volume emission contours with other measures of plasma shape. Simulations of these shape determinations were performed, using as input, a pressure profile representing a calculated MHD equilibrium for a D-shaped plasma in ISX-B. The results of these simulations are shown and the determination of the poloidal structure of MHD perturbations in the plasma is also illustrated.

3015 **Unresolved dielectronic satellites of the resonance line of heliumlike iron (Fe XXV).** Bitter, M.; von Goeler, S.; Hill, K.W.; Horton, R.; Johnson, D.; Roney, W.; Sauthoff, N.; Silver, E.; Stodiek, W. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **47**: No. 13, 921-924(28 Sep 1981).

High-resolution spectra of Fe XXV have been observed from Princeton Large Torus tokamak discharges and are used for a detailed comparison with theoretical predictions of Bely-Dubau et al. for the ($1s^2$nl-1s2pnl, n> or =3) dielectronic satellites at 1.85 A. The theory predicts a significant apparent broadening of the resonance lines of high Z heliumlike ions in high-temperature plasmas due to the dielectronic capture of electrons into outer atomic shells. The experimental results and theoretical predictions are in good general agreement.

3016 **Parametric decay of lower-hybrid waves in the ACT-1 toroidal device.** Wong, K.; Ono, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **47**: No. 12, 842-845(21 Sep 1981).

Nonresonant parametric decay of lower-hybrid waves, observed in a number of high-power tokamak rf-heating experiments,

is positively identified as a decay into ion-cyclotron quasimodes. The decay-wave spectrum, wavelength, and amplitude profile are measured inside a toroidal plasma with pump frequency f$_0$~3.5f/sub p/i~25f/sub c/i.

3017 **Confinement of high-energy trapped particles in tokamaks.** Goldston, R.J.; White, R.B.; Boozer, A.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **47**: No. 9, 647-649(31 Aug 1981).

The banana orbits of high-energy trapped particles in tokamaks are found to diffuse rapidly in the radial direction if the toroidal ripple exceeds a low critical value. During this diffusion the energy, the magnetic moment, and the value of the magnetic field strength at the banana tips are conserved.

3018 **Influence of neutral-beam injection on impurity transport in the ISX-B tokamak.** Isler, R.C.; Murray, L.E.; Kasai, S.; Arnurius, D.E.; Bates, S.C.; Crume, E.C.; Dunlap, J.L.; Edmonds, P.H.; Lazarus, E.A.; Murakami, M.; Pare, V.K.; Saltmarsh, M.J.; Swain, D.W.; Thomas, C.E. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review Letters;* **47**: No. 9, 649-652(31 Aug 1981).

Observations of radiation from iron and from argon used as a test gas indicate that co-injection inhibits impurity accumulation in the interior of ISX-B discharges, but counter-injection enhances accumulation. These results agree qualitatively with recent theoretical calculations.

3019 **Apparent and real thermal inhibition in laser-produced plasmas.** Mason, R.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **47**: No. 9, 652-656(31 Aug 1981).

Laser-driven thermal electron-transport inhibition is studied with use of a self-consistent Monte Carlo model for all the electrons. Comparison is made with the results of flux-limited single group diffusion calculations. The need for severe flux limiters is traced to deficiencies in the classical diffusion modeling that can excessively heat the overdense surface matter of a pellet, ignore coronal decoupling of the thermals, and neglect the effects of E fields for a return current through density gradients.

3020 **Time-filtering particle simulations with ω/sub p/e Δt>>1.** Denavit, J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550, and Department of Mechanical and Nuclear Engineering, Northwestern University, Evanston, Illinois, 60201). *Journal of Computational Physics;* **41**: No. 1, 337-366(Aug 1981).

The application of a time-filtering algorithm to particle simulations including low-frequency electron dynamics with time steps Δt satisfying the condition ω/sub p/eΔt>>1, where ω/sub p/e denotes the electron plasma frequency, is presented. The implicit determination of the electric field required in these simulations is achieved by using the continuity and momentum equations in conjunction with the Poisson equation in a manner guaranteeing numerical stability for long wavelengths satisfying the condition k/sub max/v/sub the/Δt<<1, where k/sub max/ is the largest wave number included in the computations and v/sub the/ is the electron thermal velocity. Several classical examples, involving two-stream instabilities, ion-acoustic oscillations and plasma expansion into vacuum are given, and the effects of aliases and of beaming instabilities are analyzed.

3021 **Absorbing boundary condition and Budden turning point technique for electromagnetic plasma simulations.** Tajima, T.; Lee, Y.C. (Institute for Fusion Studies, University of Texas, Austin, Texas 78712). *Journal of Computational Physics;* **41**: No. 1, 406-412(Aug 1981).

An algorithm of single masking in the Maxwell equations for electromagnetic particle simulation is discussed. This absorbing boundary condition is analyzed in the light of the Budden turning point condition.

3022 **Electrical conductivity of dense plasmas.** Rogers, F.J.; DeWitt, H.E.; Boercker, D.B. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Physics Letters [Section] A;* **82**: No. 7, 331-334(13 Apr 1981).

A Chapman-Enskog-type solution to the kinetic equation of Gould and DeWitt has been used to calucate the electrical conductivity of argon and xenon plasmas. Reasonable agreement with experiment is obtained.

3023 **Pulsed power particle beam fusion research.** Yonas, G. (Sandia Labs., Albuquerque, NM (USA)). *Reza Kenkyu;* **8**: No. 1, 206-215(Jan 1980).

From IAEA technical committee meeting on advances in inertial confinement systems; Takarazuka, Hyogo, Japan (29 Oct - 1 Nov 1979).

A pulsed power particle beam fusion system is developed at Sandia. The electron and light ion beam approaches represent the realistic potential for efficiency from 20 to 40 percent with the cost estimate for particle beam inertial confinement fusion roughly a factor of 10 below that for other advanced drivers. The concept for a small particle beam fusion reactor has been developed, which requires the gain of 30 pellets with energy input of 2 MJ. The energy density of a target ablator more than 10^7 J/g and the spherical implosion velocity of about 2 x 10^7 cm/sec are needed for ignition. It is necessary to deliver more than 1 MJ of MeV electrons at the order of 10^{13} W/cm^2. Magnetized, high density plasma can be used for transporting high current beam, and the use of a plasma discharge channel is proposed for beam confinement and control. For single shot experiments, the beam transport power density over 10^{13} W/cm^2 is achievable. Six beams have been propagated and combined onto a 1 cm radius target from the initial radius of 46 cm with 90 percent transport efficiency. For MeV protons, the needed energy density can be achieved at current density of about 10^7 A/cm^2. Ion beam must reach the target region at current density of about 10^6 A/cm^2. One approach to achieve such high ion density is to employ an external magnetic field. The ion production efficiency of 80 percent was achieved. A compact TW module has been developed, using parallel plate, water-insulated pulse-forming lines. The Self-magnetic insulation in vacuum transmission lines can be used to reliably transport electromagnetic energy to within a fraction of a meter of the target. Sandia has begun fairly broad investigation into various aspects of high average power sources.

3024 **Alternating dimension plasma transport in three dimensions.** Grad, H. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). pp 261-284 of Computing methods in applied sciences and engineering. Proceedings of the 4th international symposium held in Versailles, France, 10-14 December 1979. Glowinski, R.; Lions, J.L. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From 4. IRIA international symposium on computing methods in applied science and engineering; Versailles, France (10 Dec 1979).

The alternating dimension method of solving macroscopic adiabatic and transport problems is here generalized to arbitrary 3-D toroidal plasma confinement systems. The principal new result is the derivation of an evolution equation for the poloidal and toroidal fluxes in which second derivatives can be explicitly exhibited to show that the system is diffusive. This extends previous results in 2-D, axial symmetry and helical symmetry where the flux functions for the magnetic field are explicit consequences of an ignorable coordinate and the EBT closed magnetic line configuration. The eigenvalues (diffusion coefficients) are evaluated and are shown to represent one-dimensional relative diffusion among the adiabatic variables, independent of the representation (e.g. whether diffusion is measured relative to mass, or toroidal flux, or poloidal flux). The skin effect diffusion coefficient decouples from the other coefficients and represents diffusion of one magnetic field component relative to the other. Other transport coefficients such as those for mass and energy flow are intrinsically coupled. As in previously implemented alternating dimension codes, a 3-D code built to these specifications should be expected to be extremely accurate and efficient.

3025 **Numerical simulation in plasma physics.** Samarskii, A.A. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). pp 285-303 of Computing methods in applied sciences and engineering. Proceedings of the 4th international symposium held in Versailles, France, 10-14 December 1979. Glowinski, R.; Lions, J.L. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From 4. IRIA international symposium on computing methods in applied science and engineering; Versailles, France (10 Dec 1979).

Plasma physics is not only a field for development of physical theories and mathematical models but also an object of application of the computational experiment comprising analytical and numerical methods adapted for computers. The author considers only MHD plasma physics problems. Examples treated are dissipative structures in plasma; MHD model of solar dynamo; supernova explosion simulation; and plasma compression by a liner.

3026 **Linear and non-linear calculation of resistive magnetohydrodynamic instabilities.** Killeen, J.; Schnack, D.D.; Shestakov, A.I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 305-324 of Computing methods in applied sciences and engineering. Proceedings of the 4th international symposium held in Versailles, France, 10-14 December 1979. Glowinski, R.; Lions, J.L. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From 4. IRIA international symposium on computing methods in applied science and engineering; Versailles, France (10 Dec 1979).

The time-dependent, linear and non-linear, resistive magnetohydrodynamic, numerical models that have been developed are reviewed. The purpose of these codes is to compute growth rates, mode structure and saturation of tearing, rippling, and interchange modes in fusion experiments. Cartesian, cylindrical, helical and toroidal geometries are used in the applications. The numerical methods are described and applications to reversed field configurations are presented.

3027 **Numerical treatment of linearized equations describing inhomogeneous collisionless plasmas.** Lewis, H.R. (Los Alamos Scientific Lab., NM (USA)). pp 325-334 of Computing methods in applied sciences and engineering. Proceedings of the 4th international symposium held in Versailles, France, 10-14 December 1979. Glowinski, R.; Lions, J.L. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From 4. IRIA international symposium on computing methods in applied science and engineering; Versailles, France (10 Dec 1979).

There is considerable current interest in the initial-value problem for the linearized equations which describe small departures from equilibrium of a fully ionized plasma in which one or more of the particle species can be treated as collisionless. The basic linearized equations are presented in a general context, specialization for one nonignorable coordinate is indicated, and a formulation for numerical work is introduced. Numerical aspects of the problem are discussed including choice of matrix representation and methods of solution.

3028 **Fluid model numerical code system for tokamak fusion research.** Azumi, M.; Kurita, G.; Matsuura, T.; Takeda, T.; Tanaka, Y.; Tsunematsu, T. (Japan Atomic Energy Research Institute, Tokai, Ibaraki). pp 335-356 of Computing methods in applied sciences and engineering. Proceedings of the 4th international symposium held in Versailles, France, 10-14 December 1979. Glowinski, R.; Lions, J.L. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From 4. IRIA international symposium on computing methods in applied science and engineering; Versailles, France (10 Dec 1979).

The authors describe the project TRITON, the main objective of which is development of a fluid model numerical code system (TRITON) for the tokamak fusion research. Numerical methods and applications of constituent codes of the TRITON system are presented illustratively. Basic concept and concrete form of the system are also demonstrated with explanation of codes in supporting subsystems.

3029 **Partial equilibrium disturbances in high-current pulse discharge plasma.** Gippius, E.F.; Kolesnikov, V.N. (AN SSSR, Moscow. Fizicheskij Inst.). pp 475-476 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3030 **Principle kinetic and dynamic processes in high-current pulse discharge plasma and their influence on the state of plasma.** Gippius, E.F.; Ilyukhin, B.I.; Kolesnikov, V.N. (AN SSSR, Moscow. Fizicheskij Inst.). pp 477-478 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3031 **Departure between electrons and heavy particles temperatures in an argon arc discharge.** Gomes, A.M.; Bacri, J. (Toulouse-3 Univ., 31 (France). Centre de Physique Atomique). pp 479-480 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3032 **Decay of the Balmer spectrum and the two-fluid model of the H_2-arc plasma.** Kreutzberger, G. (Technische Univ. Muenchen (Germany, F.R.)); Jordanov, J. (Bylgarska Akademiya na Naukite, Sofia). pp 481-482 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3033 **Deviation from local thermal equilibrium in an atmospheric argon arc plasma.** Leclair, J.; Schram, D.C. (Technische Hogeschool Eindhoven (Netherlands)). pp 483-484 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3034 **Diagnostic method for plasmas in a PLTE situation - application to argon plasmas.** Moity, J. (Observatoire de Paris, Section de Meudon, 92 (France)). pp 487-488 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3035 **Stabilized hydrogen arc as a radiation standard in vuv from 600 to 900 A.** Asinovsky, E.I.; Kochubei, D.I.; Nizovsky, V.L.; Shabashov, V.I. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). pp 489-490 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3036 **Radiation loss from nitrogen arcs.** Shayler, P.J.; Fang, M.T.C. (Liverpool Univ. (UK)). pp 505-506 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3037 **Equilibrium compositions and thermodynamic properties of an Ar + H_2 + N_2 plasma.** Tyrkiel, E. (Institute of Nuclear Research, Warsaw (Poland)). pp 509-510 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3038 **Calculation of radiative characteristics of xenon discharge.** Zakharov, A.I.; Zemtsov, Y.K.; Skorokhod, E.P. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). pp 511-512 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3039 **Analogy method at Elenbas-Heller equation investigation.** Desyatkov, G.A.; Engelsht, V.S.; Gurovich, V.Ts. (AN Kirgizskoj SSR, Frunze. Inst. Fiziki i Matematiki). pp 513-514 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3040 **Theory of ablation stabilised arcs.** Kovitya, P.; Lowke, J.J.; Stokes, A.D. (Sydney Univ. (Australia). School of Electrical Engineering). pp 515-516 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

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3041 **Momentum generation in a high current arc.** Kulessa, R. (Technische Hochschule, Ilmenau (German Democratic Republic)). pp 517-518 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

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3042 **Simple theory of free burning arcs.** Lowke, J.J. (Sydney Univ. (Australia). School of Electrical Engineering). pp 519-520 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

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3043 **Magnetically driven plasma flows in high current free burning arcs.** Ramakrishnan, S.; Stokes, A.D.; Lowke, J.J. (Sydney Univ. (Australia). School of Electrical Engineering). pp 521-522 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

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3044 **Distribution of conductivity in high current discharge channel in air.** Alexandrov, A.F.; Savichev, A.T. (Moskovskij Gosudarstvennyj Univ. (USSR). Fizicheskij Fakul'tet). pp 523-524 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3045 **Investigations in the current zero region of an SF_6 arc.** Branston, D.W.; Mentel, J. (Siemens A.G., Erlangen (Germany, F.R.). Forschungslaboratorium). pp 525-526 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3046 **Temperature variation in the long post arc channel.** Lafta, H.; Tarocinski, Z. (Lodz Univ. (Poland)). pp 527-528 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3047 **Influence of electrode material on properties of high current arc in SF_6.** Mnatsakanyan, K.G. (Vsesoyuznyj Ehlektrotekhnicheskij Inst., Moscow (USSR)). pp 529-530 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3048 **Helical arc column model.** Afanasiev, A.A.; Pakhomov, E.P. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). pp 531-532 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3049 **Phase velocity of high pressure helical arc movement in longitudinal magnetic field.** Asinovskii, E.I.; Afanasiev, A.A.; Pakhomov, E.P. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). pp 533-534 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3050 **Combined rf-dc discharge and damping of the helical instability of arc column in axial magnetic field.** Batenin, V.M.; Roddatis, V.K. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). pp 535-536 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3051 **Note on velocity and configuration of an arc driven by a weak magnetic field.** Rothhardt, L. (Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Elektronenphysik). pp 537-538 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

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3052 **Voltage gradient of electric arc in fully-developed turbulent flow of air.** Zhukov, M.F.; Zasypkin, I.M.; Mishne, I.I.; Sazonov, M.I. (AN SSSR, Novosibirsk. Inst. Fiziki). pp 539-540 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

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3053 **Interaction of rotating magnetic field with gas stabilized electric discharge in a plasma arc heater.** Smigielski, J.; Szczepanska, H. (Polska Akademia Nauk, Gdansk. Inst. Maszyn Przeplywowych). pp 541-542 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3054 **Rotation of two low-current arc plasmas in a graphite tube.** Vukanovic, D. (Belgrade Univ. (Yugoslavia). Tehnolosko-Metalurski Fakultet); Vukanovic, V.; Simic, M. (Belgrade Univ. (Yugoslavia)); Nickel, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). pp 543-544 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3055 **Turbulent heat transfer in output electrode of plasmatron with interelectrode insert.** Zhukov, M.F.; Zasypkin, I.M.; Mishne, I.I.; Sazonov, M.I. (AN SSSR, Novosibirsk). pp 561-562 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

3056 **Plasma flow structure of two-stream plasmatron.** Asanaliev, M.K.; Engelsht, V.S.; Samsonov, M.A.; Zheenbaev, Z.Z. (AN Kirgizskoj SSR, Frunze. Inst. Fiziki i Matematiki). pp 563-564 of Proceedings of the 13th International Conference on Phenomena in Ionized Gases, Berlin, September 1977. Contributed papers II. Berlin, German Democratic Republic; Physical Society of the GDR (1977).

From XIII international conference on phenomena in ionized gases; Berlin, German Democratic Republic (Sep 1977).

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The separatrix profile of a purely poloidal field-reversed configuration is determined from excluded flux data, allowing an improved determination of the plasma dimensions. Only gross features of the external separatrix, with scale lengths comparable to the coil radius, can be resolved.

3120 **Visual method for determining the elastic buckling strength of glass microspheres.** Milewski, J.V. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **52**: No. 11, 1647-1650(Nov 1981).

To meet specific fuel filling requirements, it is important to know the buckling properties of microspheres used in laser fusion targets. A visual technique for determining the room temperature elastic buckling strength of microspheres is described.

3121 **Fusion experimental power reactor (epr) design tasks.** Anon. (Gen At Co, San Diego, CA). *Electr Power Res Inst Adv Power Syst Div Rep EPRI AP;* No. 1347, vp(Feb 1980).

Several key physics and technology problem areas which were identified in a previous Experimental Power Reactor study were investigated. These were plasma confinement, plasma heating, reactor refueling, and reactor first wall regeneration. The plasma confinement experimental studies showed no instabilities or enhanced transport in the trapped ion regime. The RF heating experiments indicated that RF could produce highly efficient plasma heating. Two reactor refueling schemes were considered in a theoretical analysis: the first was the convective transport from the cold plasma blanket to the plasma interior and the second was the use of high speed frozen pellets to carry the fuel to the plasma interior. Both schemes were shown to be feasible. Finally, the "in-situ" replacement of first walls using atomic coating processes were considered. The vapor deposition of carbon was shown to be promising.

3122 **Current status of fusion reactor blanket thermodynamics.** Veleckis, E.; Yonco, R.M.; Maroni, V.A. (Argonne National Lab., IL (USA)). pp 3-30 of Thermodynamics of nuclear materials 1979. Vol. 2. Proceedings of an international symposium held by the IAEA in Juelich, Federal Republic of Germany, from 29 January to 2 February 1979. Vienna, Austria; IAEA (1980).

From International symposium on thermodynamics of nuclear materials; Julich, F.R. Germany (29 Jan 1979).

The available thermodynamic information is reviewed for three categories of materials that meet essential criteria for use as breeding blankets in D-T fuelled fusion reactors: liquid lithium, solid lithium alloys, and lithium-containing ceramics. The leading candidate, liquid lithium, which also has potential for use as a coolant, has been studied more extensively than have the solid alloys or ceramics. Recent studies of liquid lithium have concentrated on its sorption characteristics for hydrogen isotopes and its interaction with common impurity elements. Hydrogen isotope sorption data (P-C-T relations, activity coefficients, Sieverts' constants, plateau pressures, isotope effects, free energies of formation, phase boundaries, etc.) are presented in a tabular form that can be conveniently used to extract thermodynamic information for the α-phases of the Li-LiH, Li-LiD and Li-LiT systems and to construct complete phase diagrams. Recent solubility data for Li_3N, Li_2O, and Li_2C_2 in liquid lithium are discussed with emphasis on the prospects for removing these species by cold-trapping methods. Current studies on the sorption of hydrogen in solid lithium alloys (e.g. Li-Al and Li-Pb), made using a new technique (the hydrogen titration method), have shown that these alloys should lead to smaller blanket-tritium inventories than are attainable with liquid lithium and that the P-C-T relationships for hydrogen in Li-M alloys can be estimated from lithium activity data for these alloys. There is essentially no refined thermodynamic information on the prospective ceramic blanket materials. The kinetics of tritium release from these materials is briefly discussed. Research areas are pointed out where additional thermodynamic information is needed for all three material categories.

3123 **Structural alloys for superconducting magnets in fusion energy systems.** McHenry, H.I.; Reed, R.P. (National Bureau of Standards, Boulder, CO (USA). Thermophysical Properties Div.). pp N2.5/7 (1-8) of Structural mechanics in reactor technology. Transactions. Vol. N. Thermal, materials engineering, and structural mechanics problems of future fusion reactor power plants. Pt. 2: Structural mechanics problems of fusion power reactors. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The behavior of selcted alloys for superconducting magnet structures in fusion energy systems is discussed with emphasis on the following austenitic stainless steels (AISI grades 304, 310S and 316), nitrogen-strengthened austenitic stainless steels (types 304LN, 316LN and 21Cr-6Ni-9Mn) and aluminium alloys (grades 5083, 6061 and 2219). The mechanical and physical properties of the selcted alloys at 4K are summarized.

3124 **Mechanical studies for supraconducting toroidal field coils of large tokamak fusion device.** Aymar, R.; Roux, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee); Bourrier, P.; Dubois, C. (Societe de Controle Technique et d'Expertise de Construction (SOCOTEC), 75 - Paris (France). Dept. Genie Industriel et Nucleaire); Millard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. des Etudes Mecaniques et Thermiques). pp N2.4/6 (1-6) of Structural mechanics in reactor technology. Transactions. Vol. N. Thermal, materials engineering, and structural mechanics problems of future fusion reactor power plants. Pt. 2: Structural mechanics problems of fusion power reactors. Jaeger, T.A.; Boley, B.A. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The design of TORUS II SUPRA concerns a large sized Tokamak of the next generation.

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3125 **Finite element solution of a reduced Fokker—Planck equation.** Fyfe, D.; Weiser, A.; Bernstein, I.; Eisenstat, S.; Schultz, M. (Department of Computer Science, and Department of Engineering and Applied Science, Yale University, New Haven, Connecticut 06520). *Journal of Computational Physics;* **41**: No. 1, 327-336(Aug 1981).

A linearized Fokker-Planck equation governing the particle loss rate from large magnetic and potential square-well fields is solved using the Rayleigh—Ritz finite element method with tensor-product splines. The results are compared with those obtained from an approximate analytical theory and previous numerical work.

3126 **Solution of the Fokker—Planck transport equation by matrix factorization.** Andrade, A.; Oliphant, T.A.; Kammash, T. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *Journal of Computational Physics;* **41**: No. 1, 367-381(Aug 1981).

A matrix factorization method is used to solve the Fokker—Planck (Landau) charged particle transport equation. By treating all phase space variables as discrete in analogy to S/sub n/ neutronics, the collision term takes on a five-point difference form which is readily treatable by this method. In order to illustrate this technique, the energy deposited by fast ions in a geometrically spherical, Maxwellian background plasma is calculated. Although this technique can be generalized to other geometries, its essential elements are best illustrated in this simple context.

3127 **Effect of logarithmic transformation on the probability of misclassification.** Beauchamp, J.J. (Union Carbide Corp., Oak Ridge, TN); Folkert, J.E.; Robson, D.S. *Commun. Statist.-Thero. Meth.;* **A9**: No. 8, 777-794(1980).

The probability of misclassifying an observation as coming from one of two populations, using the discriminant function, is evaluated for the case when it is known that the original observed random variables are lognormally distributed. The misclassification probabilities are evaluated under the incorrect assumption that the observed random variables are normally distributed and also evaluated after applying the appropriate log transformation. The difference between the corresponding probabilities of misclassification is used as a measure of the effectiveness of the transformation. Different combinations of the underlying population parameters are considered to allow for comparisons in terms of population separation and relative population abundance. The results are presented in graphical form and vividly show the effect of the correct use of a data transformation. 8 figures.

3128 **Computing methods in applied sciences and engineering. Proceedings of the 4th international symposium held in Versailles, France, December 10-14, 1979.** Glowinsi, R.; Lions, J.L. (eds.). Amsterdam, Netherlands; North-Holland (1980). vp. (CONF-791201—).

From 4. IRIA international symposium on computing methods in applied science and engineering; Versailles, France (10 Dec 1979).

Separate abstracts are presented for each of the conference papers included in the data base.

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Qualifier
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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